DEW LINE—the story of America's best kept secret now can be told. This is the story of the three-thousand-mile Distant Early Warning line—America's electronic Paul Revere. Spanning the northernmost reaches of the North American Continent, it stands as an impregnable radar fence against large-scale attack across North Polar regions by enemy long-range bombers and fighter planes.

DEW LINE is the dramatic account of how the almost impossible task of building this final link in the 10,000-mile warning loop around our country was accomplished. From the initial period of planning in the summer of 1952, from the building of an experimental span across the Arctic shore of Alaska, to the ultimate completion of the 3,000 miles of radar installation with the back-breaking task of flying in personnel and equipment to build these stations in subzero temperatures in the long Arctic nights—all is recounted as the vivid story of accomplishment it is.

DEW LINE

BOOKS BY RICHARD MORENUS

Alaska Sourdough

Crazy-White-Man

DEW Line

Frozen Trails

The Hudson's Bay Company

Northland Adventure

DEW LINE

Distant Early Warning
The Miracle of America's
First Line of Defense

by RICHARD MORENUS

RAND McNALLY & COMPANY
New York *Chicago* *San Francisco*

First Printing, September, 1957

Library of Congress Catalog Card Number: 57-13163
Printed in the United States of America

to

N. S. M.

Acknowledgments

No book of this sort could ever be written without the whole-hearted co-operation of the men who planned, helped to build, and to service the DEW Line. In my entire writing career I have never experienced such friendly help as I had in securing the data for this book. I am grateful to Brig. Gen. Stanley T. Wray, chief of the Air Materiel Command's Electronics Defense Systems Division, for his wise counsel and moral support. For essential information and details I am especially grateful to Capt. James Sunderman, USAF, Major Ben Miley, USAF, Major Harvey Yorke, USAF, Lt. Col. Charles F. Hinkle, USAF, Major Charles Franks, USAF, Major B. W. Clinger, USAF, Lt. Col. Clair Towne, USA, Col. Broun Mayall, USAF, Major J. G. Rose, USAF, and members of the Royal Canadian Air Force. I am also grateful to J. Clifford Johnson of the Western Electric Company, as well as to many others who worked and serviced the Line, for their inestimable help.

R.M.

CONTENTS

THE LIFELINE

CHAPTER ONE

ONE OF THE GREATEST DRAMAS OF ALL time was being produced. The principals were four men whose attention was riveted on a huge map some thirty feet away. Their faces were grave with responsibility as they slowly but inexorably were being forced to issue one of the most critical commands in our history. It was a command that could instantly plunge our country into a state of atomic war. Their decision would be based upon the developments on the map they watched.

The scene was taking place in a large windowless room, thirty by sixty feet and two stories high, built into a block-constructed building located at CONAD, the Continental Air Defense Command at Colorado Springs, Colorado. The room itself was the Combat Operations Center.

The four men were high-ranking officers, the joint command of our Continental Air Defense Command

under the Joint Chiefs of Staff. One of the four was the Commander-in-Chief of this operation under whose operational control are all the forces of the Army, the Navy, and the Air Force allocated or in any way assigned for air defense purposes. The other three officers were of the Army, the Navy, and the Air Force.

They were seated at a long desk in the glassed-in command booth set high into a wall of the big room. Below them, between the booth and the floor, two tiers of desks extended the length of the room. Here other men were sitting, singly, their full attention focused on the map. They were trained officer personnel who specialized in operating one of the most intricate and highly efficient communication systems in the world. This system insured direct contact with all Continental Air Defense Command units throughout the United States, Canada, Alaska, and Newfoundland. These men, too, were tensely alert as they watched, waiting for the word to come that they both expected and dreaded.

The room itself was silent; its sound-proofed walls and ceiling swallowed every sound. The semidarkness was broken only by light from the face of the map, from the shaded desk lamps along the tiers, and from the booth above. Although the atmosphere of the place was solemn, it crackled with a sense of vital expectancy.

The map on which their eyes were fastened showed the United States, Canada, Alaska, and the polar region etched on a single pane of plexiglass, twenty by thirty feet. It dominated the entire wall. On it the rapidly changing markings were being studied. The figures and

symbols appeared as if by magic and as mysteriously disappeared only to reappear at a new point as operators, working on scaffolds behind, marked the code signs and numbers. Flashing colored lights in panels at either end of the map—yellow for "alert" and red for "impending attack"— completed its function of presenting the position and flight pattern of every unidentified aircraft. This information was received from established radar defense sites unerringly detecting and reporting the presence of planes, and from alert members of the Ground Observer Corps, scanning the skies and funneling their findings through their local Filter Centers. As these data were forwarded to this operations center, the facts and figures appeared on the map. It all took just a few seconds. The markings showed the types of planes, if that had been established, their approximate altitude, and the direction in which they were flying. Their progress was maintained on the map until they were fully recognized and justified, or if necessary, taken out of the air.

This reporting goes on constantly, around the clock, for both the United States and Canada. The map is under continuous observation—the map which is the heart and soul of our country's system of air defense—the four men sitting in the booth being its brains.

The pattern of the drama was now rapidly developing on the map. Each new marking added positive proof that a climax was close at hand. Hardly more than ten minutes before the map had been clear. Suddenly a light had flashed which indicated an "alert." This warning was quickly followed by a chalk mark on the

map to a place east of Alaska and north of the continental boundary. Apparently a message had been received from the DEW Line, the Distant Early Warning radar line, extending across our northernmost continental limits north of the Arctic Circle. There, at the first showing of an unidentified plane on one of its radar screens, word had been flashed by ionospheric scatter broadcast, which had then been picked up instantly by the CONAD receivers in Colorado Springs, and seconds later the news was chalked on the map.

As new symbols appeared, it was evident to the men watching that trouble was in the making. The latest marks showed alien planes in mass formation, jet-powered, flying at high altitude, and headed south. If these were Soviet planes on an attack mission—and there was every reason to believe they might be—it would be cause for serious concern.

Why the Soviets? There may be other nations equally opposed to our way of doing things, but no other nation, so opposed, has the air force or facilities for launching a large-scale attack against us. The direction from which we could most logically be attacked would be from across the polar regions. By that route any target in the United States is within a flying radius of 4,500 miles from Soviet bases.

As yet, however, in the drama that was progressing there was no detailed identification as to the exact type of aircraft these planes were; and the Soviets have several types. But since the planes had been identified as armed invaders, they must be turned back or destroyed

before they could get through to a target and drop their loads of lethal luggage.

The drama being plotted on the map had reached its critical point. The questionable planes, already identified as enemy, had passed over the DEW Line and within four and certainly less than six hours could reach our border and their potential targets.

Throughout the United States and Canada the interceptor units of jet aircraft, and the speediest of fighters, on a constant twenty-four-hour-a-day alert, were ready. Pilots in the base operations readyrooms were prepared as always for all emergencies. (Heretofore, alarms fortunately had resulted in mere investigations of some plane off its course or an unscheduled flight.)

In the command booth, three telephones hung from their hooks at the edge of the desk. One was black, another white. These the Commander-in-Chief had used frequently since the first warning. This time, however, he reached for the third one. He paused just a moment before lifting the instrument and turned toward the officers seated alongside him; they nodded agreement to his unspoken question. This phone, on which his hand rested, was different from the other two. This one was red, bright red—the "hot line" in direct contact with every interceptor unit in the United States and Canada. An order into this telephone would send jets, radar-directed, on the mission of meeting the alien planes. Our entire air arm would then go into action in full-scale defense against invasion, and the battle, for there would be one to the finish, would

be fully directed by these four commanding officers from their booth in this Combat Operations Center at Continental Air Defense Command.

The next call would warn commercial and private planes out of the air, alert all cities and towns within the possible danger zone for evacuation, alert all Army ground and antiaircraft units, and activate civil defense units. All this would be accomplished quickly.

Final word would be sent to the Joint Chiefs of Staff in Washington that an attack and its armed defense was in progress, and that it was a possible prelude to war.

The General looked at his watch. From the time the first warning had been received of the unidentified planes flying into our radar range across the Arctic, until the moment he reached for the "hot line" phone, which would in a matter of seconds put our entire air defense in action, was something a little less than fourteen minutes! He took a deep breath, glanced at the officers beside him, and smilingly relaxed.

The play was over, and for the good of all mankind it was fortunate that it was only a rehearsal. In the thoughts of every man who took part were sincere prayers that this drama would never be acted out in real life.

The setting of the foregoing is real, the cast and all the props are true, only the data was improvised to show the sequence of events following the detection of a questionable plane within our defense borders.

Notwithstanding the fact that this briefing session

was simulated, those who were present were conscious of tension. These men said that it is not a case of being prepared "if it happens," but that our maintenance of an infallible defense must be founded upon the premise of "when it happens." We dare not wait to *get* ready, we must *be* ready, strong in defense against this ever-present threat with which we live, if we wish to maintain our safety and peace.

The officers in command at Colorado Springs headquarters were appointed by, and are directly under, the Joint Chiefs of Staff in Washington. Four-star General Earle E. Partridge, USAF, the Commander-in-Chief of CONAD, is flanked by Lieutenant General Joseph H. Atkinson, Commander of the Air Defense Command; Lieutenant General Stanley R. Mickelsen, Chief of the Army's Anti-Aircraft Command; and Rear Admiral Hugh H. Goodwin, who heads all Naval and Marine forces allotted to the Air Defense mission. This is the first true "joint" command inside the United States in the history of the country. Defense officials feel it is no longer possible to defend our nation in a split-second world without such unified, centralized control.

Later in the afternoon two officers, who had been on duty in the Combat Operations Center during the briefing, were walking toward the officers' club.

"You know, things like that are good," one of them said. He was a major in the Air Force. "I wish everybody could see it."

"How so?" the other asked. He was an Army captain.

"Make people think! Suppose that was for real, that

briefing today. And you well know it might be. Suppose we did have a mass attack across the Arctic? And you know as well as I do it could be. And what if we didn't have the DEW Line? We'd be sitting ducks, that's what we'd be . . . gone goslings.

"Why, if those jet bombers could cross the Arctic and get to our border without detection, we wouldn't have a chance of stopping them from clobbering just about any spot they'd pick. That DEW Line gives us time, and time is what we need. We get from four to six hours of warning, at present jet speeds, from the second a blip hits their radar.

"And do you know how long it took from the first blip until our intercepts were in the air today? Fourteen minutes! And that's fast! If the real thing happens, we'll need every minute of time we can get. I say my prayers a dozen times a day, just being grateful for that DEW Line."

"You ever been up to the DEW Line?" the captain asked.

The major grinned. "Been up there? You're looking at a man who helped build it. And there's a story of rough going. Sometime, if you've got a week to listen, I'll tell you. That DEW Line is 3,000 miles of the tightest radar in the world, built in three years, with nothing to start with but an idea and about a million square miles of icebergs and snowdrifts. But she's finished, and she works, and, if you want to know what I think, the DEW Line is our lifeline. And the building of the DEW Line, Captain, is quite a story!"

THE SUMMER STUDY GROUP ANSWERS A QUESTION

CHAPTER TWO

WHY DO WE NEED THE DEW LINE? anyone might ask.

To get the answer, we first go back to August 6, 1945. On that day the first atomic bomb to be used in war was dropped. After the explosion, Hiroshima, a city then about the size of Atlanta, Georgia, was left a shambles, three-fifths of the city demolished, littered with uncounted dead. And this devastation had been made by a bomb still in its experimental stage. The civilized world, realizing this was just a sample, was stunned by the terrible promise in the ultimate destructive force of the atom.

It was not until some time after the close of World War II that the international race for arms supremacy really began. Many German scientists had found their way into Russia. During the war these scientists had developed a practical rocket missile, the V-1, which

brought great destruction to Britain when it was loosed; later they equipped another, the V-2, with a jet motor. No one knows how near Germany was to cracking the atom, but they must have been very close to it. For the Russians, with the aid of the German scientists' know-how, have shown such progress in nuclear fission that their developments are on a par with our own, and in some phases, are ahead of our achievements.

However, other German scientists came to America and are now regarded as the most loyal and prominent among our own men, devoting their knowledge and efforts to meet our needs of defense.

Another heritage of World War II was speed. Just at the close of hostilities the jet plane was becoming a possibility as a fighter. Since then supersonic planes have become standard in the air forces of the major powers. With these elements of terrific speed, and tremendous power, and the destructive explosive force of the atom, the whole pattern of warfare has changed, and the aspect is frightening.

The Soviets were quick to change the form of their forces. Soon after World War II they launched a program of building up a strong long-range air arm as rapidly as possible. At that time our own B-29 had made flying history, and this became the pattern of the Russian's first long-range bomber, which they called the TU-4. It was very close to the B-29 in performance, and the planes were immediately put into heavy production and turned out in large quantities. Next the Soviets began to work on and perfect both jet and turbo-

prop aircraft. Today these newer craft are replacing the outdated TU-4 in their air force.

The Russians have also developed a twin-jet bomber quite similar in plan and performance to our B-47. Also in the line of bombers is one of their more recent additions, a four-engine jet. The Soviets claim a great performance record for this one, equal, so they say, to our eight-engine B-52. Then too, they have also produced a long-range turboprop bomber. Our Air Force does not use a turboprop as a bomber, but we do use it successfully as a transport plane. It has long range, power, but relatively not too much speed. In producing this as a bomber, the Soviets apparently decided that it would be better to favor longer range, even at the sacrifice of speed. This turboprop aircraft of theirs can fly over great distances at either low or extremely high altitudes.

The startling thing about all this is not so much that the Russians are producing effective aircraft, but that they are doing so in great numbers, at an alarming rate. And even more disturbing is the fact that any one of their bomber units penetrating our defenses would be capable of striking crippling or annihilating blows with a variety of nuclear, or thermonuclear weapons. The Soviets have them all.

While all this was being accomplished in Russia with the avowed purpose of developing the world's greatest striking force, the United States dared not let them get ahead. We had no actual wish to pour billions into armaments, but since we were probably the ultimate target there was no alternative. We not only had to build a de-

fense system stronger than any potential attack force, but we had to keep on building to maintain it.

That was the situation in 1952 when one of the choicest groups of scientists in the country was called together to answer the question, "How can we best defend our country against a mass air attack?"

These men had been selected for their individual brilliance. They were outstanding men, the nation's best in varied fields of science. They had already smashed atoms. They had helped to design planes that broke the sound barrier. They developed bombs powerful enough to make islands disappear and to blast holes in the bottom of the ocean. They had built electronic machines capable of doing practically everything except thinking and expressing emotion. These men were called at the request of the Air Force from their work in laboratories around the country, to meet at the Lincoln Laboratories of the Massachusetts Institute of Technology, at Lexington, Massachusetts. The number of scientists, their names, and where they were from, were kept secret; and since much of the discussion would undoubtedly have to do with the mechanics of communications, engineers and scientists from the Bell Laboratories were included.

Although it may have been known that the meeting was being held, its purpose was not publicly divulged, and for security reasons they were called merely the "Summer Study Group." Then, with the patience that only scientific folk seem to have, they approached their problems.

First, they reasoned, an attack could reach our borders only by a crossing of the Atlantic or Pacific oceans; or from bases in South or Central America, or Mexico; or from the north across the Polar Cap. The group, agreeing that any such attack would be Communist-planned, quickly saw that our northern border was the most vulnerable because it offered the shortest mileage from known Soviet air bases.

"What we need, of course," one remarked, "is time. Sufficient warning of an attack so we can get into the air to intercept. And for other obvious reasons, such as the evacuation of cities, we will need all the time we can possibly get. With planes at jet speeds, the warning will have to be an early one, if we hope for a successful defense. I'd suggest a warning system be built right about here." With a finger he traced an arc on the map along the line of the Arctic Circle.

Another scientist smiled. "That would do it," he said. "Radar. Right along the top of the continent, as far away from us as possible northward, as you mentioned, giving us the maximum time of early warning of invading aircraft. A solid shield of radar across the North would do it."

"How far is it across there?" one asked.

The map scale showed approximately 3,000 miles from Pt. Barrow, in Alaska, to a probable eastern terminus on Baffin Island.

"It would be a tremendous undertaking, but it would give us, I judge," said one, "between four and six hours of warning. From the instant radar picked up the enemy

planes and word was radioed out, with the planes at average jet speed, we would have just about four to six hours. I believe that's the best we could hope for. At least it's the logical answer to this part of our problem."

"And the logical becomes the practical when the solution of how to do it is reached," was a scientific reply. "Only one thing left to do, and that's to figure out the way to build it."

They continued their deliberation, and after an exhaustive study of the entire continental defense sent a complete proposal to the Department of Defense in Washington.

The group had not only arrived at the correct answer to the question, but at the same time deposited on somebody's doorstep the gigantic task of building the continuous 3,000-mile wall of impregnable radar along the frozen wastes of the Arctic Circle, using equipment, much of which had not yet been developed.

These men were so convinced that their proposal would be accepted that, instead of going their separate ways, they continued to work, inventing some of the trickier electronic equipment their plan called for. So, while others enjoyed the soft summer days of Massachusetts vacations, the scientists spent long hours in the laboratories. The Bell System, with their phenomenal resources of electronic and sound research and knowledge of communications, was accepting more and more responsibility for these developments. The System itself is unique. It is composed of the American Telephone and Telegraph Company, the Bell Laboratories, and

the Western Electric Company, which is the manufacturing, purchasing, distributing, and installing unit for the complete organization. As a result of these combined efforts, inventive genius and practical application were united at the top level.

The immediate problems were radar and radio. We may wait a long time before we know exactly what these scientists did and how they did it, for the operational secrets of the DEW Line are closely kept. But we do know that these men started from scratch, inventing as they went, making the parts by hand, and actually assembling the type of radar and radio which would guarantee successful operation in the Arctic. This involved intricate electronic systems that would have to function in a country where 80° below zero temperatures were not uncommon in the winter; and masts and towers that would have to withstand summer cyclones and one-hundred-mile-an-hour winter gales. Such difficulties they took in their stride, but the thought-provokers were the ones that called for designing radar and radio circuits that would operate in spite of the vicious electrical storms of the summers, the fluctuating currents of the Magnetic Pole, and the strange phenomena of the northern lights. Otherwise, the DEW Line would be marked for failure.

The Study Group began working round the clock. And if they worked with more than the usual zeal of a scientist trying to solve a problem, the stimulation was their knowledge that the success of their project might mean survival of the nation.

They checked and re-checked every step, but even when their laboratory results checked out they were not satisfied. These men were meticulous in detail and left not one thing to chance. They knew only too well that a laboratory success needs a practical workout before it can be fully accepted. So, they asked for test spots to try out their brain children, and got them.

They wanted one that would give them the actual conditions under which the Line would operate. They were given Barter Island, a small island just off the Arctic coast of Alaska, and not far from the Canadian border. It is about 240 air miles north of the Arctic Circle. The Air Force put down a landing strip and began a series of shuttle flights to carry in supplies, machinery, scientific equipment, and scientists. No time was lost in establishing this first DEW Line experimental post. Radar, radio, power plants, generators, every integral unit of electronic and electrical detail were most thoroughly tested. Changes were made in design and format of equipment until the inventors and planners were fully convinced that they had successfully proved every step. So secret were these summer activities kept, that even the families of those doing the actual work knew nothing of what was going on, or even where it was taking place.

Among the things that the scientists developed and proved in their Barter Island station were automatic alarm circuits, which enable the radar to give an audible alarm whenever a target enters the radar view. This does away with the necessity of having the radar con-

tinuously manned with watchers. This was designed to simplify operation, to give more positive warning of the presence of an intruder, and to reduce the number of personnel in the entire DEW Line activity.

Another development was made to insure radio communication. To overcome the unpredictable Arctic magnetic influences, the men at the Lincoln Laboratory found a way to force radio waves through these obstacles, in what they called "scatter" broadcast, which literally pushed the radio waves up into the troposphere or the ionosphere where they bounced and returned to the earth for proper reception after hurdling or bypassing the ground interference. This was another of the Summer Study Group's tested achievements. Power plants, diesel engines, generators, technical equipment were flown into Barter Island, and both radar and radio were assembled, tested, and approved.

Beside this practical-application site in the Arctic, the Study Group asked for another. Amid some of Illinois' rich farm land a strange-looking object soon took form. Farmers watched with great interest, asked lots of questions but got no answers, as a boxlike building was erected and domed with what looked like a huge rubber ball. Local interest grew as men came and went, usually carrying cases or boxes. Conjecture was that the Weather Bureau was trying some newfangled idea to control tornadoes, drought, or floods. Or, perhaps, it was a new TV gadget of some sort. All this very hush-hush activity was bewildering to local folk, for they had no idea that the DEW Line's magic was secretly

being practiced in this building. As a matter of fact, they had no idea that such a thing as the DEW Line had even been dreamed of.

This building was the other test site, where technical equipment was not only tried, but where men were being trained in the care, service, and operation of new electronic wonders. For these were carefully selected technicians who were being fully introduced to the intricacies of a DEW Line site. They were the ones who would man the line itself.

When the scientists were thoroughly convinced that their electronics were satisfactorily and practically complete, they took steps to insure sources of supplies for the specialized equipment. The necessary design specifications were next developed for the letting of contracts to individual suppliers. Manufacturers were called in, and part by part the units were let out under private contract. Hundreds of small businesses across the country suddenly found themselves making *something*. They didn't know what it was for or where it was going, their instructions were merely to fulfill the detailed specifications of their order. They were working on the DEW Line and didn't know it.

The designing of the DEW Line installations was so thorough that sectional parts with complete electrical circuits could be assembled at the site without tedious wiring detail. This added to the insurance of operating perfection, and simplified not only the assembly, but the work of repair and maintenance.

It is almost inconceivable that all this was accom-

plished in just the summer and early fall of 1952. It was in December of the same year that the Defense Department took action as a result of the Study Group's investigation and gave whole-hearted official approval of this defense plan, with the sole suggestion that since two-thirds of the full line would be in Canada, the initial effort should be a test segment across Alaska, on our own land, on our time, and at our cost. While this was being accomplished, the arrangements with the Dominion could be made for the complete DEW Line as the major factor in our continental defense.

With this clearance to the Air Force, the Bell System was then asked to undertake the full responsibility as the primary contractor for engineering, construction, installation and operation of a chain of radar and communications stations on Alaska's northern coast—*and have them functioning within a year!*

It was also proposed: "Make preliminary surveys of a route across the Arctic, assess the logistic and construction problems involved in creating the complete line, and develop techniques for their solution." There in one sentence is probably the greatest single construction order ever issued. The Bell System accepted the assignment, and Western Electric was given the job.

Western Electric started a new file and headed it: PROJECT 572.

not complete at all. Leave out powerful arguments against which A.F. had to overrule by a "lead to Collier mag.

PROJECT 572

CHAPTER THREE

THE NORTHERN SHORE OF ALASKA, facing the Arctic Ocean, is a bleak, desolate tundra waste. Here and there a few Eskimos eke out a hazardous living, hunting and fishing. To the south, the flatland rises abruptly to the heights of the rugged Brooks Range, whose mountains stand as ice and snow-covered sentinels of the North. In the summertime, the shore flatland thaws to an impassable soggy muskeg. In the winters, which are long and severe, it is a snow-swept barren waste, hundreds of miles of storm-ridden snow and ice. It was along this shore that Project 572 was to be built.

At Western Electric headquarters, the files marked Project 572 began to swell. Orders, memos, suggestions, data of every sort began to collect in quantity, and each marked "urgent" or "rush" or "immediate attention." It seemed that everything pertaining to the ex-

perimental line had to be done simultaneously and now. And this was virtually true. It was a tremendous undertaking, which not only called for the most careful planning, but also for unprecedented speed and accuracy in accomplishment.

Here are some of the major categories of the project:

Siting. Three distinct types of positions were to be established. The Main Stations with rotating radar would have full service and logistic support capability; Secondary Stations, also with rotating radar, lacked only the complete service functions of the Main Stations; and third, the "Gap Fillers" to complete the unbroken electronic fence by the use of nonrotating radar. Each station was most carefully spotted with scientific accuracy to present an uninterrupted protective field.

The western end of this experimental line was fastened at Pt. Barrow, the northwest tip of Alaska, and extended eastward to the Canadian border. Although this is only some four hundred air miles, no one knows how many miles were actually flown by the Air Force, piloting scientists back and forth along this dismal shore to pinpoint the one right location for each of the radar sites.

Pt. Barrow was practically made to order for use as a base. Every necessary facility was already there. It had been a World War II Navy camp and was complete with landing strip, warehouses, and barracks. It more than adequately served its new essential pur-

pose as a working headquarters and supply base. It was also from here that the siting flights were made. The scientist-engineers had spent long hours in studying maps and knew exactly what they wanted. It was only a question of flying with skilled Air Force pilots until they located the right number of spots in the proper places. There was nothing especially dramatic about it; it was merely cold, hard, dangerous work that had to be done, so they did it no matter that most of the time the weather was about as dirty as weather could be.

At each point where the scientists made a selection, they flew low and dropped marker flags for the guidance of the location crews who would follow up as quickly as possible to ready the site for occupation. Although it was winter, this preparatory work had to be done if the deadline was to be met.

Construction. Although the Western Electric Company was fully responsible for the over-all development, design, engineering, construction, procurement, logistics, training, and administrative services, in order to augment and facilitate the building, outside subcontracts were let. For consultation on architecture and engineering and design, La Pierra, Litchfield and Partners were appointed. For the actual construction work for the experimental line, two west coast firms were made responsible: Johnson, Drake and Piper, Inc. and the Puget Sound Bridge and Dredging Company. These organizations, in turn, became responsible for the delivery of the massive quantity of freight, equipment, and supplies to be delivered to the Arctic, and for the

erection of the housing, buildings, and towers at the radar positions.

Supplies and Procurement. One of the greatest tasks was listing, buying, and delivering the prodigious amount of equipment that would be needed. First of all, and most important, were the various complexities of the electronic equipment. There were the structures in which it would be housed. Then came the buildings for the operators and the crews; warehouses for storage of supplies; the steel towers for the radar masts and radio aerials; hangars for planes; workshops; tanks for fuel storage; power plants; electrical generator systems; and all the accompanying details, such as the fuel to fill the tanks, food for the men, spare parts for the equipment, and the heavy machinery, the bulldozers, tractors, trucks, and cranes. All this and more was required for each site. There was almost complete duplication for every unit. It meant that everything that might be needed from a box of tacks to a twenty-ton bulldozer was planned for, purchased, and delivered to Seattle for ultimate shipment to Alaska. This whole task would be hard enough under ordinary circumstances, but it became a purchasing agent's nightmare when so many things needed were not yet built, or designed, and some not even invented.

Things such as the radar and radio had been designed but were not in production. Housing details were not yet planned. Therefore, architects and designers, tool-workers and inventors, were called upon to furnish ideas and plans.

Especially needed was the type of building that would withstand the Arctic and serve practical purposes. There were also the electrical systems, and problems of plumbing and water sources to solve. So it was that every attendant detail of needed equipment had to be considered, planned, built, and be ready for shipment, and all with practically no delay. Literally thousands of purchase orders for immediate delivery were issued to almost as many businesses.

Personnel. From the beginning it was obvious that no single organization could build or man so intricate and immense a system as the DEW Line. The needs were so highly diversified that people of many skills were needed. For instance, besides the highly specialized electronic engineers to maintain the functional equipment, there were needs for such others as well-drillers, riggers, truckmen, men to handle bulldozers, painters, electricians, plumbers, cooks, motor mechanics, aviation mechanics, engineers, geophysicists, and laborers. And not only was there a need to have a few of these available in the various categories, but to have them several deep, and each man trained. It was one thing to outfit the Line, and another to maintain an active reserve of replacements.

The Western Electric personnel men traveled far and talked long in securing and screening the essential personnel. A few hundreds of the experts came from their own organizations, such as the American Telephone and Telegraph Company, its affiliates, and from the Bell Telephone Company of Canada.

The subcontractors were also busy in securing men with building skills. Almost every occupation that is needed to keep a small town functioning could be found in these construction crews.

Again, because of the shortness of time, many of these men had but precious little indoctrination. Fortunately, they did not need the training for their personal abilities, but it would have helped if they could have been seasoned a bit for the conditions under which they would be expected to work. Other than a refrigerating plant and a strong fan that could blow a subzero one-hundred-mile blast, there would be few places where the conditions could be simulated. So they learned about the North the hard way. They took it as it came.

Shipping. Piece by piece and crate by crate material began to arrive in Seattle, bearing the legend Project 572. The winter season, chill and rainy, was in its height, but that did not slow down the movement of this freight. Shiploads of equipment, supplies, and drums upon drums of gasoline, lubricating and fuel oil, took the protected inner passage north to Alaska, where they were unloaded. This freight then went overland to Fairbanks, and from there by air to Pt. Barrow. All that winter a steady stream of materials moved by ship, truck, and plane from Seattle to the working base on the Arctic shore.

These shipments included the basic tools and supplies necessary to prepare the sites, and to make ready for the arrival of the electronic equipment which would come later. The heavy machinery that was needed,

such as some of the diesel engines, the tractors, and the like, were taken apart for easier handling in shipment and for the flight from Fairbanks, to be reassembled at Pt. Barrow. Whatever was actually needed went in one way or another.

As the ships took the basic material north, the wharfside warehouses in Seattle began to fill with more thousands of tons for the experimental line. This accumulation would wait until some time in August, when the Bering Sea and the Arctic shore would be free of ice for a scant few weeks, during which navigation would be possible. Then after the 2,800-mile trip by sea, the supplies would be deposited at Pt. Barrow and also directly on the beaches where the radar stations were set up.

As if all this weren't enough, there was the somewhat staggering outlook that if the experimental line came up to expectations and proved a success, there would be more than 2,000 miles of additional line to build, that this Project 572 was but a small-sized sample of things to come. Since all these things were proceeding simultaneously, there was a minimum of delay. Everything seemed to unfold in the right way, at the right time. Even the building specialists who were called upon to solve the housing problem quickly found the right answers. They experimented with almost every possible type of material, concrete blocks, metal, wood, and combinations of all three. Finally they came up with a very simple and thoroughly practical modular-unit structure which, when assembled, was 16 feet by

28 feet by 10 feet high. Made out of prefabricated and pre-insulated panels which had been processed, these units were knocked down, and were among the freight to reach Pt. Barrow by air. They were assembled there in a heated hangar, where the work could be comfortably done; then they were mounted on sledlike bases and linked together end-to-end, like a line of boxcars. A caterpillar tractor pulled them to their permanent locations. These tractors, or "cats" as they were called, were the workhorses of the frozen trails. Paradoxically, there is very little actual snowfall in the Arctic, perhaps as little as four to six inches all winter. The winds do, however, beat the snow to tremendous drifts in some places where there are hummocks; otherwise these frozen muskegs are firm-surfaced for the "cats" to have good traction for their lugs.

Late one afternoon in January, a crew of new men arrived at Pt. Barrow. As they got out of the plane, they saw a group of grinning Eskimos standing off to one side of the runway. These friendly natives bobbed their heads and seemed almost to be doing a little jig. The pilot noticed some of the new men staring, and said, "These Eskimos are good Joes. They're friendly, and they're always on hand to give us a good welcome. But if any of them invite you for dinner, don't go, unless you like stewed walrus stomach or a good chewy chunk of frozen sealflipper."

The next morning added its own welcome to the newcomers, topping off a moaning fifty-mile wind with a nippy 40° below zero. These men were assigned to a

new site and were taking a "cat" train out that day.

One of the men who was preparing to climb into his full Arctic issue began to moan a bit about the bulk.

"Bro-ther! Get a look at this load of clothes! Back home, my mother could have dressed all five of us kids with what I've got to put on."

"You'll be mighty glad you got it all in one place, my friend," was the rejoinder from one of the men who had been up there a couple of weeks. "Layer by layer."

"I'll bet if an Eskimo got into this outfit he'd suffocate. Look," and he held up the articles one by one like a salesman showing his wares. "Wool union suit, flannel shirt, wool pants with a lining, three pairs of wool socks, felt boots, mukluks, wool jacket, nylon overalls padded with down, fur-trimmed parka, or 'parky'—I guess I'd better learn how to pronounce it—wool gloves and overmitts, and dark glasses."

He paused briefly, but the other men were far too busy getting into their own clothes to pay too much attention to him; so he shrugged and began to get into his "uniform." Usually newcomers go through a period of adjustment, a sort of weathering-in process to become gradually accustomed to conditions. But this takes time, and time was one luxury these men did not have, not even to spend in getting acquainted with the weather.

"You're right about the Eskimos, pal," one of the others chimed in. "But you haven't got a few thousand years in back of you of living on walrus guts and blubber. These folks up here were born in an icebox; we're hothouse plants. They wear a layer of caribou skin, some

fur pants and a parky, and they're warm. But we can't do that, so we wear all this.

"I've worked in this cold country before, and I can tell you a little about dressing for the steady deep cold we'll have up here. The important thing is to wear wool next to the body, or like the Eskimo, fur, and an outer covering that is windproof. The body has to breathe, so it's got to have ventilation. One of the greatest dangers in the north is perspiration. If you begin to sweat, and this subzero cold gets to you, you'll think you've been bitten by forty of the choicest devils. It's a paralyzing pain, and it's also a pretty good way to freeze to death.

"Now, the Eskimo knows these things, so he's worked out a type of practical wearing apparel that's been passed right down unchanged in style or form. Look at the fur he's got around his parky hood. Wolverine. It's the only fur that won't frost. And the Eskimo knows the importance of saving his eyes. He makes snow glasses out of pieces of bone. He'll carve it so it fits over his eyes, and he'll cut a couple of narrow slits through. Otherwise, the glare of the sun on snow or ice will blind him. You'll see what it's like, and you'll wear your dark glasses. You don't want to get a touch of snow-blindness; that *really* hurts.

"You'll be glad you got all these clothes. Wait till you start bucking one of these one-hundred-mile-an-hour breezes when it's pushing fifty below zero cold ahead of it. You'll see, pal."

The Eskimos watched with great interest and

amusement as the crews got their "cat" train ready to move out. Loyal to their teams of faithful hard-working dogs, they reluctantly finally admitted that the "cats" could outpull their dogs, but pointed out that the dogs still had certain features of superiority. The dogs could run all day on a feed of frozen fish. They didn't need to be greased or oiled, and they were always ready to work. There was always a young dog to replace an old one. "Cats," they also pointed out, required a full supply of spare parts, and were pieces of machinery that wore out at an amazing rate, running steadily, as they did, in the subzero temperatures. Nevertheless, during Project 572 the "cats" pulled prodigious loads over thousands of miles of tundra in establishing the Alaskan line of test sites.

The train was fully made up and ready to take out, five modular-unit structures or "modules" and the wanigan on behind. (The wanigan is to the trail-train what the caboose is to a freight. Roughly translated from some of the Indian dialects, it would mean "the-place-where-to-put-things-when-there-is-no-place-else-to-put-them." Practically, the wanigan is the cook-and-bunk shed, as well as a storehouse.)

The "cat" got under way after the simple briefing to the driver that the first site was "thataway," accompanied by a general gesture toward the east. The tractor tossed up a swirl of snow as it clawed its way onto the limitless frozen barrens, making its own trail as it went. It was soon out of sight, and in a matter of minutes the wind erased the trail. All the driver had to do was to

follow the shore line, watch for the marker flag, and pray for guidance.

The men had gone no distance at all before the North treated them to one of its most baffling phenomena. They had been pounding along in the strange shadowless murk of the long Arctic twilight when the snow and sky seemed to blend together and become one and the same. There was no snow and no sky, the horizon had completely disappeared, and their whole world had quite suddenly become the same unbroken shade of gray. There being no growth, there was nothing but the barrenness of the tundra; there were no shadows, and the sensation was one of being held suspended in space. There was neither front nor back, nor up nor down, nor any sense of movement.

The men could hear the barking exhaust of their motor and the whine of the wind. They could feel the jolting of the caterpillar treads on the ice and the buffeting of the gale. They could feel and hear activity but were completely without the sense of movement. The men were caught in a "white-out," eerie, spooky, and dangerous, caused by certain conditions of light.

When they stopped, one of the men got out to take a closer look at this strange phenomenon of the North. He turned in every direction and found that there was none, neither near, far, up, nor down. He took a few steps and suddenly was stopped cold as he walked straight into a ten-foot snowdrift. He got back to the tractor and climbed in. "Doggondest country I ever saw," he said. "You look straight at a snowdrift, but

you can't see it. Then you run into it. Invisible snowdrifts! No shadows, no nothing. Doggondest country!"

"If we go on," the driver said, "there's no way we can keep a course. We're likely to start running in circles and get ourselves good and lost. And it's easy enough to get lost in this God-forsaken country, without driving around in a vacuum. Eskimos wait these things out, and that's what we're going to do. I'll pull up and stop and let the motor run so it won't freeze on us, and go see what's cookin' in the wanigan."

So the men stopped and waited it out. It was as though they were in a void, white and bitter-cold. When shadows began again to form, they started out, and eventually found the marker flag. Here the "cat" left the train and returned to the base for another load of supplies.

The crew set immediately to work, moving the modules to the firmness of the hardest frozen ground the men had ever seen. The modules were so well designed that they fitted perfectly when joined end to end, and they became complete living quarters. Next the diesel power plant was set up, and through the ingenious use of exhaust and motor heat, the hot-water heating system was a practical success. The generators furnished light. From then on, the men devoted their efforts to the basic work of readying the site for the radar and radio installations.

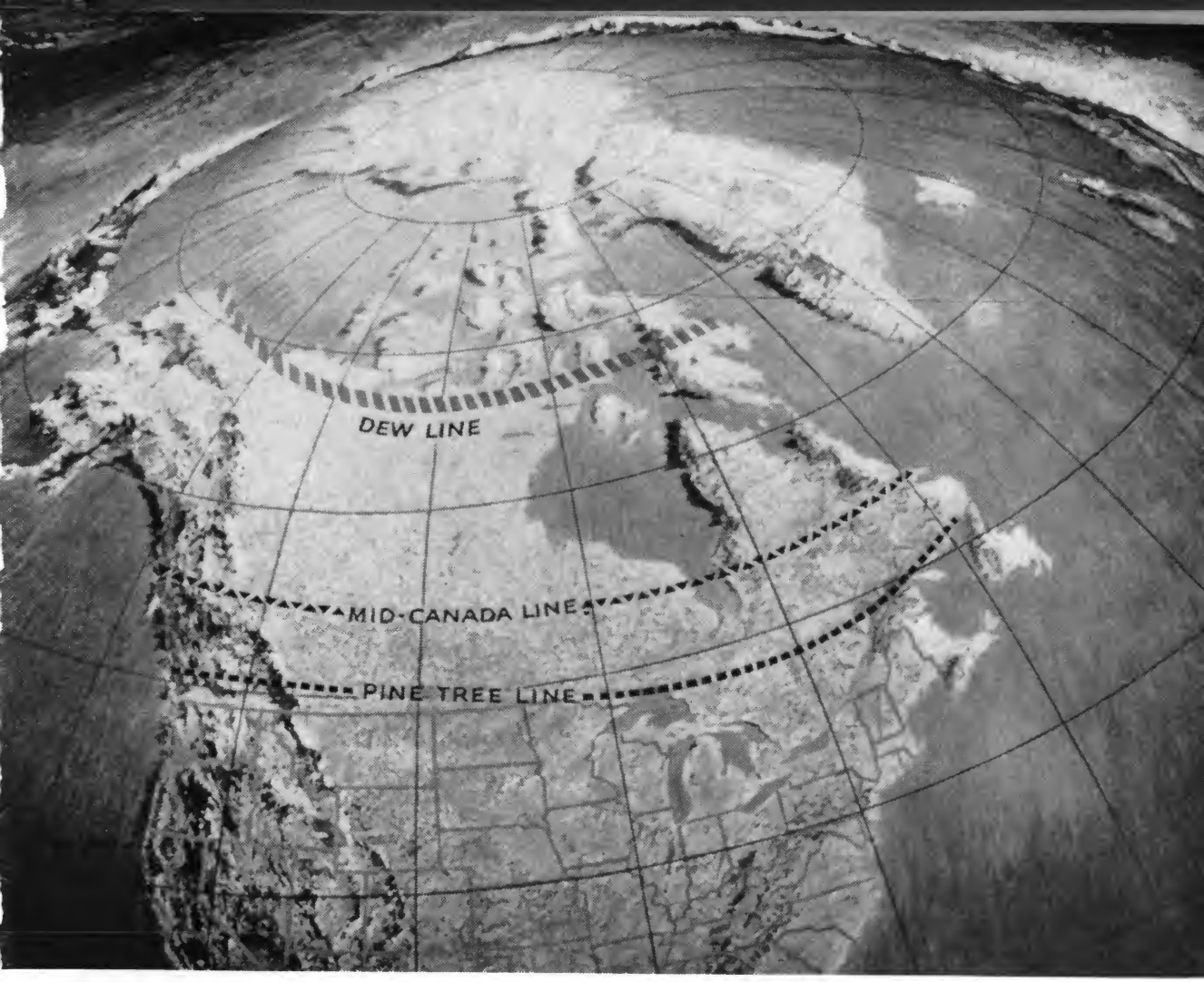
In a matter of a few weeks, they had things comfortably under control and everything was running smoothly when the North uncorked another surprise.

At one of the locations where the modules had been set up for quite a while, they suddenly began to tilt and their entire foundation softened and turned to slush. It was discovered that the heat inside the buildings, seeping downward, had slowly been melting the muskeg underneath on which they were based.

The muskeg of the tundra is a sludgy marsh, anywhere from two- to six-feet thick. This topping thaws and freezes with the summer and winter. But below this layer is the permafrost, frozen in some places to a depth of 1,000 feet, and has been in this state for perhaps 10,000 years or more.

As the heat of the modules caused this topping to thaw, a situation was created which called for quick adjustment. Word was sent out, and the answer came quickly: equipment was flown from the States including lengths of piping, complete with instructions. It turned out to be a messy job. The steam-pointing equipment looked like airhammers, but instead of breaking through, it melted a way down by forcing live steam through nozzles. The heat ate its sloshy way through the muskeg and then bore into the hard permafrost beneath. Then metal rods were set into the holes, and in a very few minutes ice clamped them in a frozen vise that would permanently keep them as stationary as a concrete foundation. The muskeg also obligingly froze again and lent its fickle support. The modules were hoisted atop this new foundation of "stilts."

Not only was it miserable and uncomfortable work steam-pointing, but handling metal at these extreme



Above: The most important link in the 10,000-mile outer ring of radar fence, the Distant Early Warning (DEW) Line lies well within the Arctic Circle. Note its far northern position in respect to the Mid-Canada Line and the Pine Tree Line. *Left:* In the early planning stages of DEW Line, day after day the USAF and RCAF flew miles along the length of the proposed line charting the area and choosing locations for the radar sites. Here a plane passes over the Brooks Range.

In the 52° below zero cold, common to the DEW Line in winter, a glass of water tossed in the air vaporizes instantly.

Construction crews lived in tents while they built each site.

No shelters for the tractors, and very little comforts for the men.

Right: The snowplow was a bit of indispensable equipment for the airlift, which needed smoothly scraped runways.

Below: The prefabs, or modules, loaded on sleds and pulled by a tractor formed the "cat" train. The group below is on its way to one of the permanent sites.

Above: Workmen, wearing fur-lined jackets and heavy gloves, assemble a steel communication tower at the DEW Line. *Below:* The platform for the radar dome has been raised and the modules have been set in their permanent location.

Above: A truck being loaded with gravel at a pit on the Arctic coast. The only natural material available, this gravel played an essential part in building the sites. *Right:* The smallest of the three types of sites along the DEW Line. *Below:* A workman warms up the gravel with a steam pointer. To pour concrete in the Arctic, the gravel, sand, and water had to be heated.

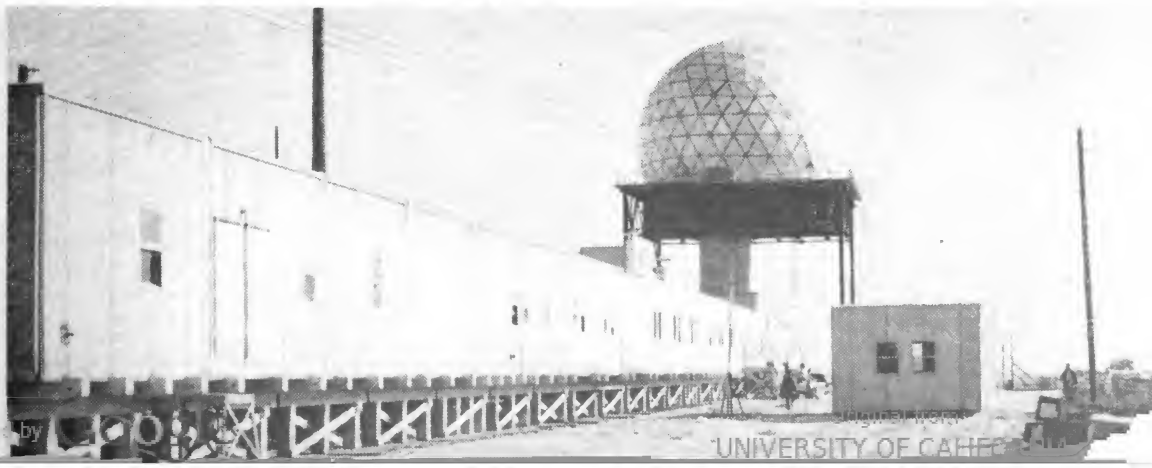
The largest of the three types of sites, called a main site, looked like this from the air while it was being built.

An August, 1957, photographic release shows a typical auxiliary station with the radar dome and the associated tower and dish-type communication antennae.

Above: A test communications antenna at one of the sites.

Left: A completed radar dome on its platform. Note the heavy frost on the equipment. At first the balloon-like dome coverings were made of rubber; then plastic was used; now a nylon shield which zips up on the inside has been developed to protect the delicate instruments from the subzero cold.

Below: Summertime is brief in the Arctic, but for a few weeks the modules are snowfree and the radar dome is frostfree.

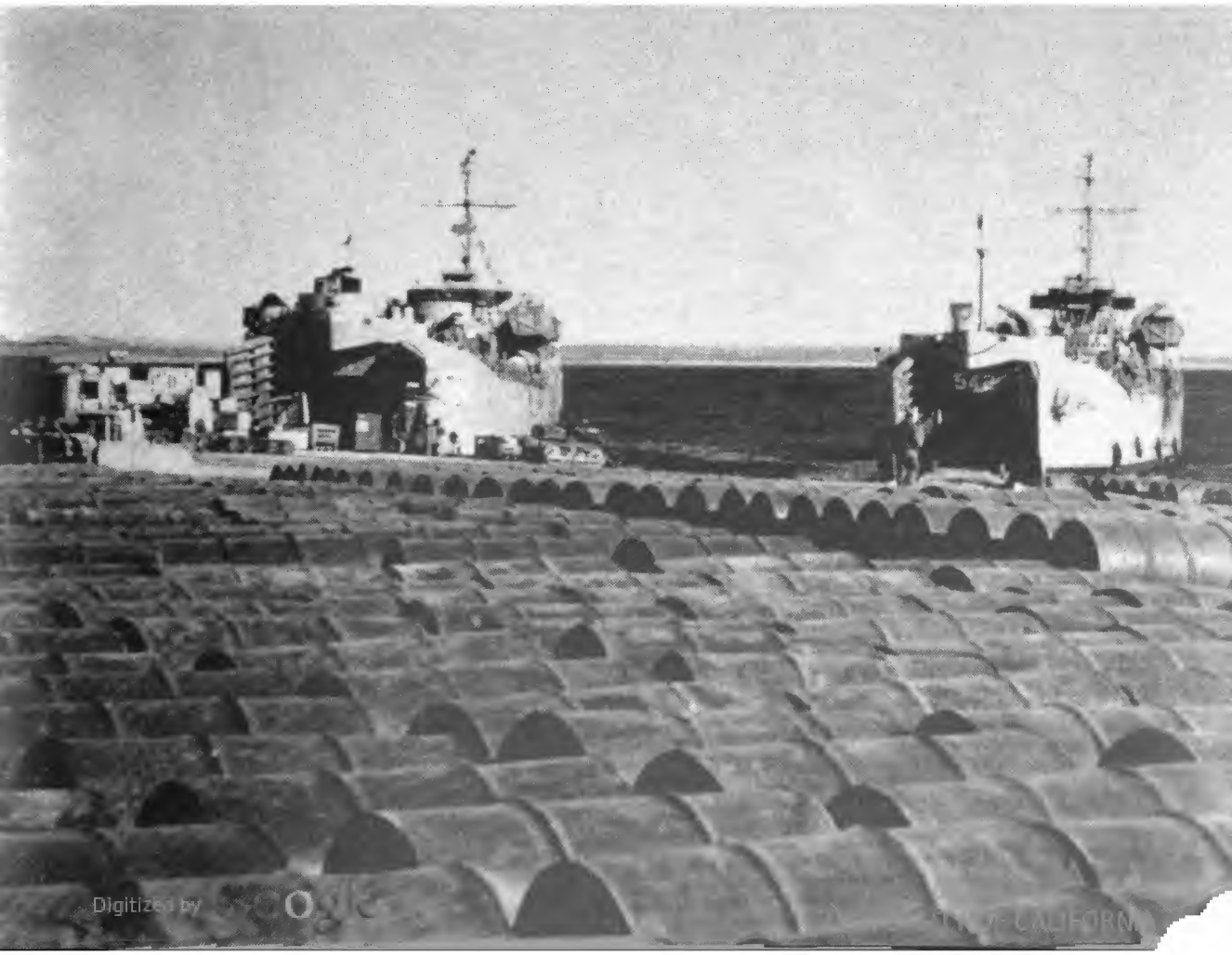


Above: Natives and the crew of a C-124 compare the old and new weapons of the hunt. *Right:* Checking ice thickness became a routine task in the Arctic where frozen bays were used as landing fields. *Below:* One of the Eskimo workmen on the DEW Line.

Opposite page: A completed main site in the summer. Note the ships in the background delivering supplies and equipment.

Above: This landing strip on the craggy Baffin Island coast was used in support of one of the isolated radar sites there. *Below:* The huge "mouth" of a C-124 Globemaster opens wide and down its tongue-like ramp rolls a caterpillar tractor.

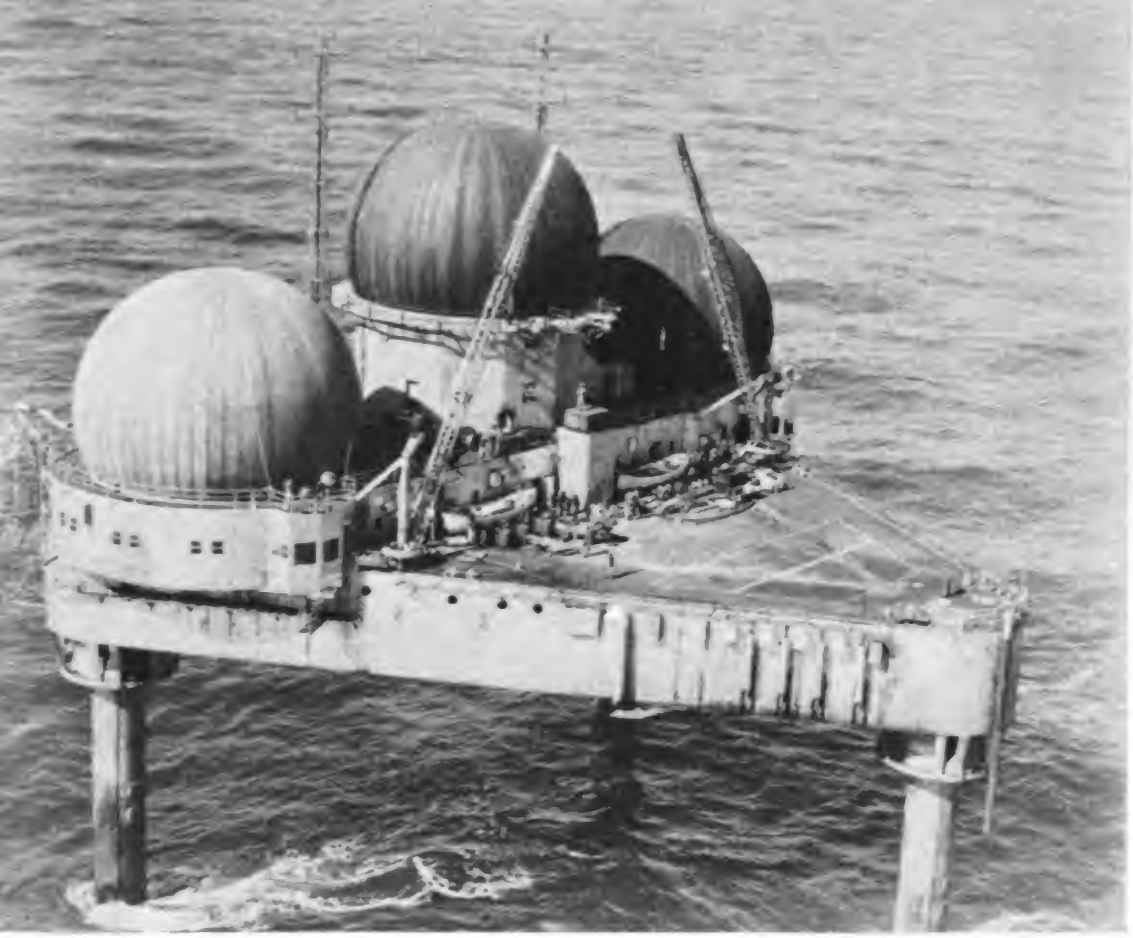
During breakup, when frozen bays were no longer suitable for landing, and before the sealift could reach many sites, maintenance of the flow of supplies and necessary equipment fell to the helicopter. *Below:* POL (oil) being unloaded somewhere in the Arctic during the sealift.



Above: The world's largest plexiglass screen, in Combat Operations Center at CONAD. On it is kept an accurate tally of any unidentified aircraft in the Arctic and North America.

Right: This WAF, an expert at writing backwards, records the unknown aircraft on the reverse side of the plexiglass screen so that it is readable by the CONAD staff.

Above: The dais of the Combat Operations Center at CONAD, opposite the plexiglass screen, where the battle staff can evaluate the information being recorded. From the glassed-in area above General Partridge will direct the defense. *Below:* Interceptor fighter pilots off to track down an unidentified aircraft.



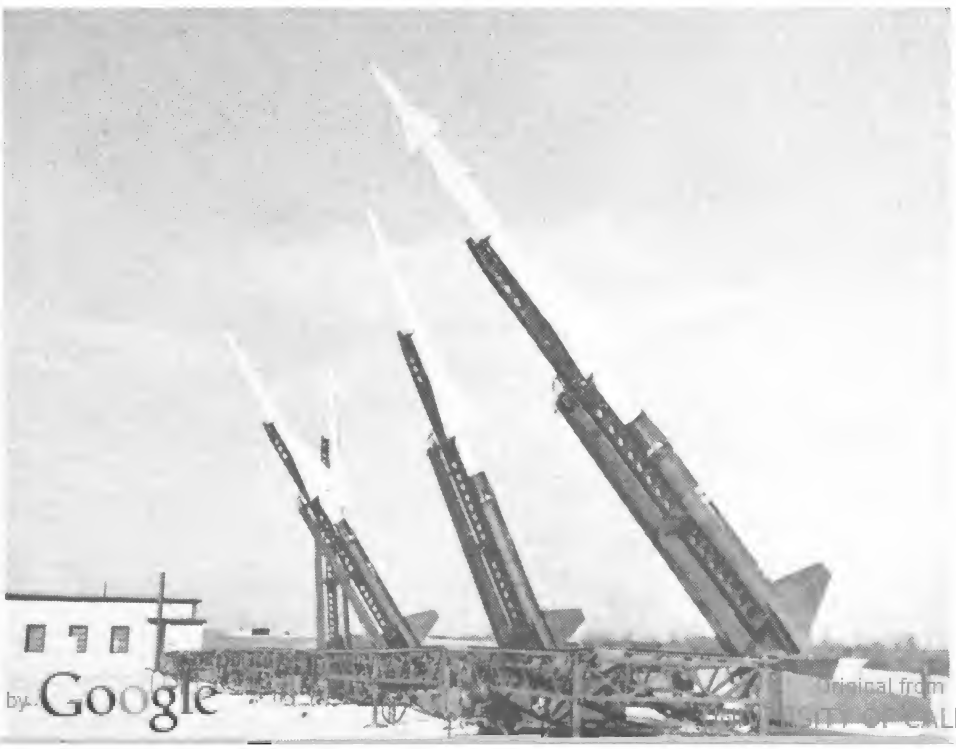
Above: Named after oil-drilling rigs, Texas Towers, located off the New England Coast, extend the radar net of DEW Line. *Below:* One of the Picket Ships, converted World War II Liberty ships, acts as another link in our 10,000-mile ring of radar.

Above: A WV-2 radar plane with the fantastic "flying saucer" on top, another extension of the radar net. *Right:* Inside a WV-2, showing men at radarscopes and plotting board. *Below:* A DDR-882, another seaborne link in our early warning system.

Above: A F-89D Scorpion fires "Mighty Mouse" rockets over the barren Arctic, where our air defense might encounter the first wave of invaders.

Left: A Ground Observer Corps post, which reports to their nearest Filter Center.

Below: A battery of four NIKE guided missiles being raised to vertical firing position at a launching site.



subzero temperatures burned even through wool mitts and outer casings. But it was all part of the job.

This new arrangement of having the modules up off the ground and re-aligned into the prevailing wind, had other advantages than to prevent them from melting a path out of sight. They presented less of a break for the wind in their new location, and the snow thereafter blew past, around, over, and under; so there was no more need of shoveling them out of drifts.

As long as there was ice the "cat" trains crept along, hauling the supplies mile after mile of monotonous frozen waste, for hundreds of miles, over trails that were or were not there, depending upon the whims of winds and snow.

One train left Pt. Barrow hauling a complete machine shop. The "cat" was equipped with radio for communication with the base. Three days later it broadcast a message that it was lost. Another "cat"' train was dispatched to look for it. Since there are no signposts, direction markers, places, or other things in the Arctic on which to get a "fix" to arrange a meeting, these two trains played hide-and-seek among the snowdrifts for more than three days. The men kept talking with each other on their radios, doing all they could to direct each other to a meeting. But the best this contact did was to keep each other company. Their trails finally crossed by the merest chance, and they were lucky in backtrailing their way out.

It is difficult to understand that it is possible in the Arctic to start out and keep right on going without ever

reaching a town, a settlement, or ever seeing another human. There are really *open* spaces here—very wide, very open spaces. The Arctic is an easy place in which to get thoroughly lost.

Days began to lengthen, until finally came the day when the sun merely did its solstice curtsy, moved along the horizon for a bit, and started its climb into the next day. From then on the word the men waited to hear was: "The ice is out!"

Spring came slushily to the North when it did arrive. The tundra melted and turned the surface into a quagmire of gummy muskeg. Clusters of small Arctic flowers blossomed in luxurious splashes of fiery color. But with the thaw and the flowers and the welcome warmth came the scourges of the North in blinding, stinging swarms of mosquitoes and black flies. The air was literally filled with the whine of their wings as the men suffered from the stings of these voracious insects. Their stay, however, was to be mercifully short, and before too long the cold again would take over and lock them once more in frost.

In Seattle a convoy of Navy ships was emptying the contents of dockside warehouses into their holds: heavy machinery, bulldozers, diesel engines, generators needed to produce the fabulous amount of electricity required at each location, and additional thousands of tons of miscellaneous equipment. The skippers were waiting only for the Bering Strait to be free of ice. When word came, they started the 2,800-mile sealift to unload their precious cargoes, some at Pt. Barrow, and others directly

upon the Arctic beaches. A strong Army contingent had been assigned to the project to aid in this freight handling, and these men were an important factor in the success of the sealift. There were a scant few weeks, mostly in August or early September, when the slush ice and floes afforded navigable water, and it took the most expert seamanship to complete these deliveries. By the time the first bite of freezing cold took hold, the equipment had been landed and the ships were back in safe, open water below the Bering Sea.

From then on, the work crews doubled their efforts, installing the radar and electronic equipment, and completing every structural and operational detail.

There was no actual schedule for the work of establishing the radar posts, except that imposed by weather, and the fact that days and weeks were gnawing relentlessly at the one-year deadline of the agreement.

Finally came the day—almost without the workers' knowledge—that the experimental line was finished. Radars were tested. The comunications by radio were tested. All was in order, and as the deep cold of the winter was once more closing in, the northern lights streamed down upon a series of weird rubber-domed structures containing the radar, the steel shapes of the antennae, and the clumps of buildings where men and equipment were keeping constant vigil. Every piece of equipment, as well as the crews, was performing to perfection.

So, with the experimental line in operation, the DEW Line had put down its roots. Frozen they were,

but they were firmly planted deep down, certain, and sure.

The men, Western Electric, the Air Force, the Navy, the Army, contractors and suppliers, had done what couldn't be done, and finished it in just under the year. It was a magnificent achievement.

In the midst of all this even the Eskimo profited. All the building activity had provided an answer to the natives' prayer for wood. It is the one thing they prize most highly. The packing cases and shipping crates furnished not only wood for fuel, but many an Eskimo was proud of his new igloo with the big black markings on its sides, "W.E. #572." The Eskimos never had it so good.

THE DEW LINE IS CHARTED

CHAPTER FOUR

THE ALASKA EXPERIMENTAL LINE paved the way in experience, and its successful operation proved the practicability of stretching the DEW Line across Canada. Formal negotiations were begun between our State Department and the Canadian government to arrive at the terms of an agreement to extend this line of defense from the Alaska border eastward to Baffin Island, more than 2,000 miles across the top of the world.

While these talks were going on, the Air Force once more called in the Bell System and Western Electric, and when they accepted this new undertaking, they found their hands were full of a project that was staggering in its size and complexity.

The experimental line they had just completed had already called upon resources and ingenuity they hardly knew they had, but that project was dwarfed

in comparison with the concept of the chore ahead.

During one of the planning sessions, one of the men said, "Building the pyramids singlehanded would be a cinch alongside this one. But we've got it to do, so let's get with it."

The first task was to check the route the Line would follow, and then to select the radar sites. Right then the survey and siting teams ran into their first difficulty. They found that there were no dependable maps of the country for them to follow. The only ones were in no sense sufficiently detailed or accurate enough to meet their scientific needs. This was understandable, for apparently up to that time there had been no reason for a detailed map of the country above the Arctic Circle. It was bleak and uninhabited, and visited only now and then by a few nomadic Eskimos. The practical answer was to make maps of their own. So they took to the air. The Royal Canadian Air Force flew hours upon hours, back and forth, along the upper rim of North America while the surveyors took thousands of photographs of the terrain below.

This was a different sort of country from Alaska. Beginning almost at the Alaska-Canada border, the farther east they went the more forbidding the country. It was mountainous, treacherous country, snow and ice covered, and barren. The men easily understood why there had been no interest in making maps up to then.

When they finished, they compared their findings with existing maps, and gave names to otherwise nameless capes, bays, islands, lakes, and mountains over which

they flew. They pored over old records of explorers. It took a matter of months to co-ordinate all this effort and put it in order. But finally it was finished, and the spotting of the actual radar positions by air was begun.

It took pilots experienced in the North to fly this country, and the RCAF co-operated to the fullest with pilots and planes. Ski gear was used for landing, and each flight was especially hazardous because every landing was made by sheer guess work and took the utmost skill. All the spots were rough but some were really rugged, and the light planes, in the gusts and gales of the dim, hazy, constant twilight of the Arctic winter, made landing no easier.

One of the RCAF pilots, back home for a rest, was asked by the base operations officer how the flying was. He laughed.

"It's getting so that any landing you walk away from is a good one."

He paused to light a cigarette. "You ought to try it some time," he said, "and see for yourself what we've got up there atop o' the world. From the air it looks like rock candy and talc, tasty and soft, but it's nothing but more rugged mountains, ice, and snowdrifts. And when the scientific fellows want to set down, and you find a place to slip onto, first thing you do is to fasten your plane to the ice you have landed on, then you spike down your tent while the boys with the electrical gadgets find out if it's the right or wrong place. If it's all right, we mark it with a flag, and if the wind isn't too bad, we'll go hopscotching to look for another likely

spot. Sounds like good fun, eh? Well, my friend, it's not."

It was all dangerous, hard work. Selecting the positions called for long, arduous flights under almost impossible conditions. It was not a case of landing just anywhere in order to take scientific observations; it was a case of electronic necessity to find the many right locations required to make the DEW Line a practical success. These were not geophysicists or meteorological men on research efforts; these fellows were actually pegging down the safety of our country with the utmost scientific certainty.

Because it was necessary for these positions to be located with such accuracy, the terrain became almost a second consideration. Some of the positions turned out to be fairly level ground, with reasonable access to the shore where ships could land supplies, if ships would ever be able to reach there. Other positions were on mountainsides, ledges, or peaks, depending upon which the scientists found most desirable. With the site established, its servicing came next.

There were two things essential to the success of each location. One, obviously, was a surface smooth enough and long enough to make a landing strip for the big C-124's, for these huge planes, weighing some ninety tons when loaded, required about a 6,000-foot strip for getting down and up. This was most important, because much of the burden of getting equipment and supplies to this new operation would fall upon these big fellows. The other essential was an

adequate amount of gravel, either free gravel from the ground itself, or from offshore reefs, or rock that could be crushed. This gravel was to be used for topping the landing strips to permit the big C-124 Globemasters to land in the summer. A top-coating of gravel, from four to six feet thick, was needed to be sure of a solid strip. If the strip could be built at the radar site, so much the better. If not, level ground was found as close as possible.

In the winter the only problem was in keeping the strips clear of drifting snow, but when the thaws came and the ground surface became the same sort of sludge as the muskeg of Alaska, then the heavy coating of gravel assured a surface on which the planes could land safely.

After the siting teams had marked the locations with flags, it was up to the ground crews to take over.

There were bases where equipment and supplies were stored, where the planes could at least receive first-aid servicing, and refuel. Here the survey crews had opportunities to rest up and to digest the data they had secured, and to get relief from the trail-cooking of their siting camps. A few of the men and pilots were sitting out a storm at one of these outpost bases before taking off on more charting flights. They began to trade experiences.

"Sometimes I wonder just how long we're going to be lucky. Like this last trip. We found just what we wanted, and were lucky in setting down at a likely spot, and we anchored our plane and spiked down our tent.

We were there nearly three weeks. Weather wasn't too bad for our location work. We climbed through drifts up to our waists and up the side of a mountain. It wasn't too cold, maybe about thirty or forty below, and we found just the right place for one of the spots. So we checked it out and marked it, and back on the flatland again we even found rock that could be chewed up to make a landing strip. It was just about as good a deal as we had found. We had shovels, and we began digging snow to make a path so one of the cargo planes could land with some equipment and gear and the construction crew could take over.

"Anyway, one of the boys flew over and decided we needed help. We got one of those little tractors dropped down by parachute, and next the pilot dropped some fuel, and were were getting along fine; it wasn't too bad. We had a strip just about cleared when whoosh! along came one of those hundred-mile blasts they unhook from the North Pole, and overnight there, buried under drifts of snow, went more than two weeks of some of the doggonedest, back-breakin'est hard work you ever did. Nothing was left but to do it all over again. Nearly three screaming weeks of it! Well, they finally got in with a small cargo job and unloaded some snow-clearing equipment, and pretty soon they'll have things under control. But it's things like that makes me wonder how I ever happened to get into this. Makes me even wish I'd flunked algebra."

There was a laugh, and quiet for a moment. Outside, the howling wind was at a high pitch and buffeted

the building with hurricane force. The snow would have been blinding for anyone foolish enough to walk into it.

"Brother!" one of the men said, almost to himself. "Listen to that. Makes a guy wonder what the devil he's doing up here."

He hitched up his chair and took a swig of hot tea. "Haah—" he said. "Nothing like tea to warm a fellow."

Then he looked around at the rest. "Any of you fellows had the extreme pleasure of being lost in this country? It's not too hard, you know. I was going out to the site one night after supper. It was twelve miles away. They were going to lift me out in a helicopter, but the weather closed in and ice began to form on the 'copter's blades, so I decided to walk. I guess it was about ten-thirty when I left, and I got to camp at four-thirty in the morning. Took me six hours to go twelve miles.

"I made a complete circle. I don't think I ever got so tired of walking, but I had to keep on. It was that fuzzy sort of white haze, and, boy, was it quiet! I'd heard about the 'silence you 'most could hear,' and you sure can! Saw lots of wolf tracks, but I didn't have a gun. I had my sleeping bag, but I was in no mind to take a nap. You know this is an awful big country to go roaming around in. You talk about luck, how about that?"

Another man looked up from the pad on which he was making notes. "I'm getting ready to send out a couple of suggestions on 'Arctic household hints,' and if any of you men have any ideas I'll put 'em in. I'm suggesting we have some rubber air mattresses between

our sleeping bags and the ground. Awhile back our crew was set down at a site, and it took us until eight o'clock to get our three tents set up and get bedded down. These double-walled tents are good. In the two big ones we had the oil-fired space heaters and in the smallest one, a small gas stove. It wasn't too cold, maybe about thirty-five below, and about a twenty-five-mile wind. That made plenty of drift, so we had to drag the air strip every day to keep it from getting too far ahead of us. Well, during that night—towards morning—one of the tents caught fire. Burned the whole doggone thing and everything in it. Nobody hurt, but everything else gone. We re-did the camp and built some snow-block walls around the tents. I don't think I ever felt so helpless in my life. Fire in this country is really something! We didn't have enough water to put out a match. Had to melt ice for what we used. But the thing was, all I had between my sleeping bag and the ground was a sheepskin. Cold! Rubber mattresses would be a help."

"Speaking of being scared," said another, "how many of you have had first-hand acquaintance with polar bears?"

A few of the men laughed.

"I'll never forget the first one I met," the man continued. "One day I was just getting up, and had stuck my head out the tent flap. There, a couple of feet away from me, was this polar bear staring right at me. I backed into the tent and got a rifle, and when I went outside again, he was still there. Then, instead of shoot-

ing, I went back and got my camera. I set the speed and focused and took five pictures. I reset the camera and took five more pictures, and that darned bear just stood still. Then I yelled at him. When he started running up the draw, I chased him until he went over a hill and disappeared. Later, I found out he had eaten all the fresh meat we had stored in the snowbank. Some of it was getting rotten anyhow, and I hope it gave him a bellyache. But when I stuck my head out that tent flap and saw that bear, I'm not kidding, I was scared."

"That was all you saw of him, eh?" one asked.

"Oh, no. We saw him again about noon the next day. He was up on the rise overlooking, or maybe looking over, the camp. We decided to kill him. We'd heard a lot about polar bears and we had a lot of food and gear. We were going out to work and we didn't want him mauling the stuff over. I fired seven shots from a .30-30, not over fifteen hundred feet. He began to move off, and I got more shells and we all went after him.

"We tracked him to a plateau, and when he spotted us he started coming toward us. When he was about fifty yards, one of the other fellows fired four more times. This dropped him, and he was threshing around as I crept to within thirty yards and shot him again. That last bullet killed him. We skinned him with our pocket knives, and what a job that turned out to be! Last time I skinned anything was a rabbit, as a kid."

They all laughed. "Biggest rabbit you ever skinned," one of them said. "What did you do with the skin?"

"We turned it in to the Mounties. There's a regula-

tion that no animal is to be killed except for self-defense. The law also says that you can get rid of a destructive animal to save your property. The Mounties gave this skin to the Eskimos, so there was no fuss about it."

Polar bears, like any other bears, are always dangerous. They are extremely curious, always hungry, and can be devilish nuisances. In the North, however, they are not looked upon as enemies. But this one bear, having found a good cache of food in a snowdrift, probably looked upon this camp, with its other enticing smells, as a good source of supply. He could have proved to be a thoroughly destructive customer if he had had his own way. If the men had left the camp unguarded, they might have returned to find it a shambles. He would eat what he could find to eat, and then, for lack of anything else to do, make an everlasting wreck of everything in sight. These bears grow to tremendous size, have terrific power, are absolutely fearless, and are most thoroughly unpredictable.

"Yes, sir, bears are sure queer people," said one of the men, who up to now had been staying strictly with his paper work. "We had one, but he didn't stay with us long. We were putting out marker flags, and one of the fellows looked back, and doggone if a polar bear wasn't following us. He'd calmly sit down and eat every flag as he came to it."

"Probably showing his resentment over you busting in on his domain," remarked a man in the corner.

"Whatever it was, he soon got tired of the taste of the flags, and went off about his own business."

The storm blew itself out, and the next day the siting teams again took to the air. They were learning that the North had infinite facets to show.

Relentless as it is, the North also has its sense of humor. At one of the surveying camps, just at dusk, a worker was coming in from the airstrip, positive he was being followed. He stopped and looked back. There was the limitless hazy-white fuzzed with powdery drifting snow. The whole world was white, dismally white except for one small shining black dot, about the size of a walnut, hanging suspended in the air about eighteen inches above the ground. Each time he turned to look behind him, there was the black dot, the same distance away, about six feet, and hanging motionless in the air. He shook his head, blinked his eyes, but the black dot remained. He had heard stories about what the North did to a fellow's mind, and wondered if his mind, too was beginning to wander. He started to run, then stopped suddenly, and turned around. The mysterious dot was still there, black and glistening. He jumped up and down, waved his arms, yelled, but the black dot was still with him when he reached his tent. He pushed his way inside.

"I've had it," he panted. "I'm gettin' out of here. When I see things like that followin' me, and there's nothin' there but a shiny ball o' black hangin' in the air, boy, I've had it! An' I mean I've had it!"

A couple of the other men laughed. "I'll bet that's only Eddie that was following you," one of them suggested. "He's hungry. Come on, I'll show you."

A few minutes later the two were outside, feeding a very friendly and very hungry Arctic fox, so pure white that his outline had been obliterated by the dusk, and only the tip of his little black shiny nose was visible.

There was rarely an entry made in any of the logs, or individual comment by the men wherein great respect was not shown for the friendliness, helpfulness, and all-around good character of the Eskimos, for whom all of this activity was a new and very strange experience. The Department of Northern Affairs of the Canadian Government, which regulates and governs all that concerns the native, insisted that no activity in any form should interfere with the Eskimos' normal way of life, or of making a living. Eskimos could be used as guides or as workers in certain types of jobs, but only after the Department agents had given their okay.

Day after day exploratory flights continued, up and back from headquarters in Canada and the States, and along the length of the proposed line, charting, locating, and making ready for the huge construction job ahead. Much of the time the flights were under almost impossible conditions. And it is to the everlasting glory of the United States Air Force and the Royal Canadian Air Force pilots that the flights were made at all.

By midwinter most of the locations were selected and marked for the construction crews. The men found that Northern Canada had a few things in common with Alaska; both were bitterly cold and barren. But there the similarity ended. Whereas Alaska had been

fairly flat along the tundra shore and presented relatively easy hauling for the "cat"-pulled supply trains, Northern Canada presented a terrain that was not only desolate, but rugged, hundreds of miles of mountains, sheer and barren, with cliffs to the shore edge. There were some stretches where caterpillars could work, some places where airstrips could be laid, and some only a helicopter could reach. But no matter what the land was like, if Engineering said, "This is the spot," then Construction would figure out a way to build a radar post on it.

All this was part of the preparation. And once the locations were definite, and the engineers were satisfied with their findings, the real work of settling took place.

The assault on the Arctic continued. Neither cold, terrain, nor any other difficulty could stem the indomitable urge of these men to accomplish their mission.

THE AIRLIFT

CHAPTER FIVE

EVEN AS THE ALASKA EXPERIMENTAL line went into successful operation in 1953, it posed a serious question. Who was to be the boss? Whose defense line was it? The United States Air Force had ordered it, serviced the building of it; the line appeared basically to be their project. But the Navy and the Army had also taken part in it. And there were four branches of our armed services that made up our system of defense, and each was under separate command. Therefore, when the radar screens picked up the blips and the news was quickly scatter-broadcast to bounce off the ionosphere, who was supposed to pick up the messages and do what with them?

For the Distant Early Warning Line to be fully effective, immediate action was essential. To achieve this, the Joint Chiefs of Staff, in Washington, organized certain elements of all the Services under one

unit command. If word of attack came, there would be no time for independent action by any of the defense commands. There would be no time for individual responses, phone calls or conferences, meetings, of strategy boards, or jockeying for prominence of responsibility for command. The very thought that prompted the urgency of the DEW Line proved the vital necessity of eliminating any possible interservice jealousies and of establishing one single point of decision. It had already been proved to the upper echelon of authority that minutes, not hours, might be the margin for preventing disaster.

On August 31, 1954, Continental Air Defense Command moved into its present administrative and functional headquarters at Ent Air Force Base at Colorado Springs. Each of the services is represented on the CONAD headquarters staff, and each has a staff of officers permanently stationed at headquarters. An Air Force general normally heads CONAD, although on occasion the temporary commander may be an Army general, or a Navy officer of general or flag rank. The Army furnishes antiaircraft units; the Navy and Marine Corps provide, to the fullest extent, their forces as required, with the Navy as an integral part of the radar line encircling the country. The Commander-in-Chief of CONAD has operational control of all the forces assigned to it, but he does not have administrative control over forces of other Services.

To facilitate defense control, the country is divided into three regions, with joint air defense forces for each: Joint Eastern ADF, Joint Central ADF, and Joint

Western ADF, each directly responsible to CONAD headquarters. At the head of each joint air defense force is an Air Force commander with operational control of the Army, Navy, Air Force and Marine Corps forces assigned to his area. There is never a moment of day or night when these units are not fully alerted and activated.

Every effort was devoted to the development of the most nearly perfect unified and harmonious command and control of our entire defense structure as could possibly be attained under our form of government.

On February 21, 1955, the first press story on the DEW Line was released by the Air Force and was published the next morning in a New York newspaper. Up to then all news about the planning and the building of the Line had been carefully withheld. The headline read: CONTRACTOR CHOSEN FOR RADAR IN ARCTIC.

The item stated that official announcement had been made by the Air Force of the appointment of the Western Electric Company, Inc. to build the 3,000-mile Distant Early Warning Line across the Arctic. It further noted that the United States would meet the full construction cost, which might be anywhere from $200,000,000 to $1,000,000,000.

It was a very small bit of copy for such a tremendous enterprise. But that obviously was the way the Air Force wanted it. The DEW Line was not to become a publicity target. Besides, because of the very nature of the undertaking, its details were so highly classified that there was precious little that could be told.

Reference has been frequently made to the vast amount of supplies to be moved into the North. We may not know how many radar installations it may actually take to form this unbroken electronic line of defense over its 3,000 or more miles. But however many there are, each must be a self-contained unit. Some would have the minimum of necessities. Others would be as complete as any small hamlet, with its own utilities, electric plant, heating plant, radio station, recreational facilities, stores, and the like, garages, gas pumps, and living quarters.

Imagine then, taking on the job of moving one of those hamlets, dismantling every building, crating the pieces and so marking them that the entire town or village could be reassembled and in perfect operation at some far-distant point. First of all, what does the town weigh? How small should the crates or cartons be in order to be satisfactorily moved? How long would it take? Who could do the work? And how could it be moved over several thousand miles when for most of the distance there is no means of land or water transportation, roads, trains, rivers, or seas? That was approximately the type of problem facing the DEW Line contractors.

Just as no two towns are the same in content and size, neither were the requirements of all the radar positions identical. Like towns, each site had its own particular services to perform. Nevertheless, each would have to be a completely unified functional entity.

Instead, however, of having to take towns apart

piece by piece, pack, and ship all the buildings—stores, warehouses, and such—as well as all they contained, the settlement groups for the DEW Line had first to be made. The pattern for the dwellings and operating buildings had already been tested and approved in Project 572, in Alaska. Therefore, to meet this basic need meant only more orders being placed with more suppliers for these knocked-down, prefabricated units. Then followed the long lists of machinery required: the diesel engines and generators; heavy tractors, trucks, and road-building machinery; bulldozers and rock crushers to build and maintain the vitally essential gravel landing strips; and thousands and thousands of gallons of gasoline, fuel oil, and lubricants. There were also the steel towers and antennae for the radar units and radio. And for every piece of structural equipment there was the necessary detail of marking. Each piece must be delivered to its proper point, and every structural unit be perfect in fit. There would be no running back to the store or factory for exchange or correction once they were delivered.

The total weight of the orders for the DEW Line ran into the hundreds of thousands of tons, and many more pieces in actual count of things to be transported.

In Alaska, the service of supply had been relatively simple, with the constantly open access to the outside via Fairbanks through Pt. Barrow and the comparatively easy hauls by "cat" train to the sites. But Northern Canada offered no such delivery system. And quite suddenly there was immediate need for great volume

of materials at the newly located DEW Line positions. To facilitate matters further, just as they had done for the Alaska experimental line, Western Electric arranged for subcontractors to do the actual building of the Canadian sectors. Northern Construction Company and James W. Stewart, Ltd., of Vancouver, B.C., assumed charge of the work in Western Canada, and the Foundation Company of Canada for the Eastern.

Following the preliminary siting preparations, the air work of delivering equipment began, and the rest of the winter saw the gigantic job of spreading thousands of tons of supplies along the 2,000-mile length across the Canadian Arctic. It was one of the greatest airlift projects the world had even seen, and as it got under way, the DEW Line's roots grew firmer.

Again the contractors found that they were neck-deep in detail and in a fight against time, and the surveying crews worked without attention to hour, day, or date. The main cry in the North was: " Get the sites set so the rest of them can go to work!" As soon as a position was marked and charted, the contractors' crews moved in and immediately began to build it into a permanent location. This required not only men, but a steady flow of equipment and supply.

The contractors' files marked DEW LINE bulged with the same detail that had filled the lists for Project 572, but multiplied many times. More thousands of orders were placed, and the cases of freight began to arrive at the wharfside warehouses not only in Seattle but on the east coast as well. Plans were to deliver the bulk

of this by ship during the few weeks in August and September when the water might be open for navigation. But in the meantime there was a mountainous stock of supplies that would have to be landed at the locations right away so that the construction of the sites along the Line would be far enough advanced for the electronic marvels and the machinery to operate them to be put into position as soon as they were landed. The only way these advance loads could be delivered was by air.

Planes for the job were recruited from everywhere possible, from commercial as well as private sources. Canadian bush pilots, the sturdy fliers who in their small planes handle freight and mail service throughout the North to trading posts and the like, were invited to participate. There were more than a hundred of these private planes in use, and even such commercial freighters in the United States as the Flying Tigers were chartered. Canadian commercial fliers furnished some thirty-five C-46's, three DC-3's, nineteen DC-4's, three PBY's, one Bristol, five Yorks, and one B-17. The USAF supplied eighteen C-124's, six C-119's, and ten ski-equipped C-47's, as well as helicopters for "local" deliveries.

The entire activity was the result of greatest urgency, and was operated under the direction of the U. S. Air Force and the RCAF. Unfortunately, there were accidents, but that there were not more is a great tribute to the skill of every pilot who participated. There were crack-ups, two of the huge C-124's were completely

washed out. Many of the smaller planes were damaged, and some totally wrecked, but the loss of life was miraculously low. Virtually all of the accidents were either in taking off or landing on the impossible Arctic terrain. The surprising thing is that there weren't more because of the hazardous and unpredictable nature of the ground conditions, as well as the fog, white-outs, snow, or wind; for most of these pilots had never had the slightest training in flying of this type.

Back and forth these planes shuttled, carrying load after load. This feat alone is more remarkable because many of the planes, especially those from the south, were not winterized and almost wholly unprepared for Arctic flying. During these early planning days the maintenance problems were great since there were no facilities at the DEW Line for plane repairs or motor overhauls. What repairs were needed had to be done outside in the biting cold mainly by the flight crews themselves. This was more in the nature of first-aid than of complete service, but it kept them flying. There was one instance where a crew had to change an entire engine in their plane. In order to get any protection from the subzero temperature while the job was being done, they asked some Eskimos for help. These friendly, practical people obliged by building a snow igloo around the plane, and in this oversized snow-block hangar the crew worked in comparative comfort.

From the very first almost every flight found new and difficult problems to overcome. The first need at any site, of course, was a landing strip to accommodate

the heavier planes. This was usually done progressively.

At one location the small planes had brought in about as much equipment as they could and the work crews were camped in their tents. But their shovels and even the light, motor-driven plows were no match for the winds and the snow. It was about all they could do to keep a strip clear for the smaller planes. What they needed was heavy equipment that could hold its own against the storms. The freight had to be delivered and the big planes had to have at least a 6,000-foot clearway for their wheel landings. The only answer was to parachute the equipment down. What the ground crew asked for was a D8 tractor and plow, all of which might weigh something over twenty tons.

Over numerous objections from Washington, the imperative need won out, and a D8 was carefully loaded on launching rollers in the belly of one of the giant C-119 Flying Boxcars. When the location was reached, the pilot made his run, as though sighting for a bomb drop, and at the proper instant the first parachute was let loose. This triggered the drop. As the chute opened behind the plane, it pulled the tractor along the supporting rollers until it toppled out of the plane. Then three huge parachutes opened.

But there had been a miscalculation. The 50° below zero cold did strange and unexpected things to the elasticity of the parachute lines—and all twenty tons of the tractor hit the bay ice and kept right on going, through the ice to the bottom of the bay.

The next time the men had better luck. The three

big chutes held and another D8 thoroughly padded, floated gently down. The crew, muffled to the eyes in their heavy parkas, were out of the tents watching as the tractor came easily to rest on the bay ice. With a shout they ran as fast as their cumbersome mukluks would permit, through blowing snow, and began to unsnarl the machine from its parachute rigging and harness. Another plane followed the first, and this one dropped the huge snowplow blade. From then on, it was no chore to clear a landing strip and keep it clear. The big D8 was able to keep ahead of the weather.

One of the crew later commented on the problem of handling the subzero metal. "If we didn't have these layers of mitts, that steel would stick to your hands and burn the flesh right off of you. But working with these mitts is almost like eating grapes with boxing gloves."

From then on the air-freight lift was assured. Most of the parachute drops where the tractors were needed were confined to smaller tractors, but the C-119's continued to let down the big twenty-ton D8's in an emergency: In some instances, tractors and other heavy machinery were dismantled before being dropped, and reassembled at the site. The problem of proper packing and padding was also solved.

Finally airstrips were leveled and cleared wherever it was possible. The C-124's required a strip of some 6,000 feet in length and 200 feet in width; these big planes, weighing with a full load up to 180,000 pounds on landing, needed length and thickness for safety. At many sites the strips were laid on frozen bays and lakes.

Although the ice of these strips was generally from five to six feet in thickness, and was strong, its strength varied greatly due to the salt content, and, strangely, the speed of its freezing. Fresh water makes the firmest ice, and wherever possible the landing strips were cleared on fresh water lakes. In many cases, however, they had to be made on ice floes composed of sea water.

There were locations, too, where no landing strips could be made because of the terrain. In these instances, strips were made as near as possible to the site. And from there the freight was hauled by "cat" train, or, as in many cases where the country was so mountainous and hillocked with ice that the "cat" trains could not navigate it, trucks took over the job. In extreme cases helicopters finished the delivery.

The equipment was handled with the utmost care. In the first place it represented a great investment in money, but more important than this was its urgent need at each point at the time of the drop. Aerial "drop specialists" were developed. Equipment was carefully and specially packed in varying sized crates. In order to have the supplies reach the DEW Line sites without damage, containers were built, especially designed to fit the roomy interiors of the C-124's, and to fill them up completely. The aircraft were stripped of all unnecessary inner fixtures to permit this. This testing, packing, and loading was all done at Dover Air Force Base, Delaware, with the 18th Air Force doing the flying. The planes reached most of the sites with only one landing en route for refueling and crew rest. In this manner,

the equipment absorbed only two minor landing jars, and almost without exception was delivered in perfect condition.

Added precautions against damage were taken for parachute drops and helicopter "local deliveries." Crates for these purposes were further reinforced for proper balance and weight and handling before they were sent to the North. Particularly so were the individual cases of delicate electronic equipment. For the helicopters, the cases were fitted with lifting bridles for proper balance and vaned to prevent twisting and turning as they were carried in flight.

"It's getting so they have these things weighted and balanced to such a fine point you can set a thousand-pound crate down on a case of eggs and never crack a shell," said one of the 'copter pilots, after he had set down a packing case containing an electric generator on the top of a mountain ridge.

This airlift, operating on a twenty-four-hour basis, called for the maximum efforts of mechanics to keep the planes flying. Bases began to be established at practical points along the Line where more complete service was available to the aircraft on around-the-clock schedule. The home bases, too, were kept busy. And throughout it all the pilots were continually learning new things about "flying the Line."

The weather was a constant challenge: the white-outs which made landings either fully impossible or sheer guesswork; the ice fog, a low-lying fog of frozen vapor which usually accompanied quick drops in tempera-

tures; sudden storms which came from nowhere and without warning, wind at gale force and with or without snow. All this and the fact that the magnetic activity near the Pole is as erratic as a whirligig.

The actual work accomplished by the airlift was almost unbelievable. In the few short months more than 2,800 flights had been successfully completed, carrying freight either from the United States or Canadian warehouses, to spread more than 42,000 tons of equipment to the sites along the full stretch of the Arctic. This entire venture was wrapped in courage and marked with brilliance.

The crews on the ground did their share, too. There was neither night nor day for them. Although the men worked in shifts, there were always some of them to greet the unscheduled arrival of every plane. There were airstrips to be kept clear, and freight to be handled, no matter what the time of day. At first these crews lived in tents; then as the modular units began to arrive, the men moved into them, and the sites took on the semblance of permanency. Throughout it all, with the normal expectancy of a few exceptions, these crews did their work cheerfully, and tough work it was. These ground work-crews were mainly Canadians; perhaps that was the reason why they were so well adapted to the rigors of the country.

Like every other facet of DEW Line activity, the airlift was a fight against time. The planes were in the air every possible moment to take advantage of the continuing cold, which made their landings on the ice

strips possible. Finally, however, with the spring thaws these landing strips became completely unsafe. But by that time the impossible had once more been achieved, and enough heavy cargo had reached the Line so that the basic building construction could be carried on in preparation for the full delivery of cargo-freight when the Navy lent a hand.

By late April the ice strips were unusable. The honeycombing of rotting slushy ice made landings no longer possible for even the lighter planes. It was too early for the making of permanent gravel landing ways, but notwithstanding these deterrents, the airlift could not stop. The men at the locations still needed food and supplies, and the steady flow of smaller equipment also had to be maintained.

Each individual northern settlement had now been established along the entire stretch of the 3,000-mile line. There they were, according to plan, and fully manned. They had radio communication with their main supply bases, so they were not completely isolated. Therefore, food, supplies, and equipment had to be dropped by parachute until the time when the permanent gravel runways could be laid. As shore ice melted and lakes gave up their solid crusts, supplying fuel oil and gasoline became simpler. Drums were merely dropped into the water, and the land crews easily fished them ashore.

The airlift created many new possibilities for research by geophysicists and other scientists. And at least one new piece of detail work was the result. There

is now at all locations where landing strips are maintained, an ice inspector, whose job it is to test the holding strength of the ice. Also resulting from this airlift effort is a Permafrost Establishment, a permanent laboratory where scientific research on the Arctic Polar Cap is carried on. This is located at Wilmette, Illinois, and is known as SIPRE, Snow, Ice, Permafrost Research Establishment. Their findings are immediately transmitted to the DEW Line for practical application.

This first winter's work in outlining, establishing, and preparing the entire DEW Line for permanent operation had again accomplished the almost impossible. It is the more interesting when one considers that this complete activity had taken place through the combined efforts of Canadians and Americans. The two countries had been in close discussion from the moment Project 572 in Alaska was conceived, and Canada was kept fully informed of all activities. As it became evident that the DEW Line could become a practical entity in defense, Canada realized the vital importance of early warning to the successful functioning of our combined defense systems, and that this entire project must be a joint responsibility. By the same token, our Government fully cognizant of Canada's sovereignty, recognized that the DEW Line would be built upon her land. The discussions, therefore, were to arrive at a practicable understanding.

To reach this there were no long, tiresome, detail-ridden international legalities or pettifoggery. When agreement was reached, it was based upon mutual trust

and was consummated in a single interchange of letters. One dated May 5, 1955, from the Canadian Embassy, in Washington, to our Secretary of State presented Canada's position. The reply, bearing the same date, was a one-page acknowledgment in full compliance. Briefly, Canada furnished the land rights for all sites; the United States assumed the entire cost of building and maintenance; Canadian contractors and labor received equal consideration with those in the States. Also Canada may achieve rights and titles when, as, and if such a move appears advisable to her. There are further details as to the ultimate disposition of the Line, and other points pertinently legal. The agreement is complete, and mutually beneficial. The exchange of letters was a sort of international handclasp over a friendly understanding. The only point upon which the two countries could not agree, and which still remains uncompromised, is that Canada insists upon spelling *defence* with a "c," while we spell *defense* with an "s." However, the meaning is happily the same.

THE LABRADOR LENDS A HAND

CHAPTER SIX

BACK IN 1576 AN ENGLISHMAN NAMED Martin Frobisher became the first of quite a line of fearless adventurers who tried determinedly but unsuccessfully to find a short cut to China in northern waters. After three tries the best Frobisher did was to touch the eastern seaboard and have an inlet named after him. Hudson didn't penetrate much deeper, but he had a river, a strait, and a bay named after him; Baffin's name was given to a bay and an island. But these explorers and several more got no farther than the Atlantic coastal waters.

The Northwest Passage became an obsession with explorers. Men suffered untold miseries; whole expeditions were lost. Many died in futile attempts to locate the elusive channel. It wasn't until 1903 that the Norseman, Roald Amundsen, made the first crossing by boat in Arctic waters from the Atlantic to the Pacific. It took

a couple of years, and strangely enough he wasn't even searching for the Passage and had no interest whatever in trade with China. He was collecting scientific data on the location of the Magnetic Pole. Then for many years no one paid much attention to the Passage until 1944 when the Royal Canadian Mounted Police had a burning desire to go around the top in a sturdy little boat, the *St. Roch.* They did it, and made headlines all over the world for being the first to get through this ice-choked lane in a single season. Ten years later, in 1954, the H.M.C.S. *Labrador* was the first naval vessel to sail through.

The Northwest Passage never became a busy or popular thoroughfare, and with the development of air transportation and faster ocean travel, the original need for such a route completely disappeared. It was as it had always been, either frozen solid and impassable, or with lanes briefly opened by the few weeks of summer thaws—even then filled with rotting slush, and always at the mercy of the floating, shifting Arctic ice islands, winds, and storms. The Passage was commercially unnavigable, uncharted, and unknown, and nearly 100 per cent useless. It was not until the summer of 1955 that there was a practical reason for using it. The DEW Line was calling for service.

All that spring of 1955, even after the local site landing strips had been rendered unusable by the thaws, the airlift continued. A permanent landing base had been made on the shore of Frobisher Bay on Baffin Island, north of Hudson Bay, and a fleet of C-119

Flying Boxcars moved in. Servicing the eastern sector of the Line, flying seven- to nine-hour missions, these huge carriers kept up the effective dropping of supplies. A group of 18th Air Force aerial drop specialists worked out techniques for the safe delivery of everything from the smallest crates up to the tractors. These men carried their own sewing machines, belting, and parachutes, and actually designed and made the parachute unit to fit the need.

On the ground the construction crews were readying levees, clearing beaches, and preparing landing approaches for the sealift. As quickly as the shore ice freed the beaches, these were leveled off, and every facility was carefully planned to take care of the cargoes promised as soon as the water lanes were safe, or approximately so, for navigation.

Again the crews were faced with problems peculiar solely to the Arctic. When the beaches came out from under the snow and ice, some were gravel and fairly simple to cope with; but this northern gravel did not pack too well and presented a somewhat shifting base as beach approaches were bulldozed and roughed out. Some stretches of beach became soft, mushy, tundra swamp, while others presented wide shelves of mucky flats, with tidal drops of as much as eighteen feet in some places. Then there were sites where there were no beaches at all, where sheer rock cliffs bored straight down as though anchoring the continent to the bottom of the sea. Some of the beaches could be worked by caterpillars from the shore. Others could be serviced by

amphibious trucks and naval landing craft. Still others would continue to receive their freight and supplies from the air, or, if they were within a reasonable distance of beaches, roads would be built for shore transportation.

The crews worked almost continuous shifts of duty. The sites themselves had to be prepared with buildings, foundations, and structural bases erected ready for the equipment, and warehousing and storage space made ready for the rest. As storms, slush ice, winds, and waves wreaked havoc to carefully prepared shore approaches, the damage was steadily repaired and the ship landing beaches were kept in shape.

While all this was going on at every site on the DEW Line, a different sort of preparation was taking place in the States. Mountainous tonnage of freight had been accumulating for months in Seattle, Washington, and Norfolk, Virginia. Several thousand Army troops assigned to the project were trained in handling this highly specialized logistical problem, especially in the fine art of stevedoring.

The RCAF maintained a School for Survival and presented a three-weeks course to their airmen in case they were stranded in the Arctic or anywhere in the Northern Canadian bush country. One of the important courses was the one on how to stay alive. The RCAF even published a cookbook with "Handy Hints to the Stranded." It is extremely doubtful that this book will ever become a family household favorite, but it is one of the most practical for anyone planning to get

lost in the northern barrens.

One of the RCAF survival specialists made this sincere and very true statement: "A lot of people, even today, scare up bogies in their own minds about the North and the Arctic, bogies that actually don't exist. There's nothing really mysterious about the North. Survival is merely a question of knowing just what the dangers are, and how to recognize them, and how to take advantage of the resources offered by the country. It's a matter of using common sense plus various techniques."

The course, in full, covered northern geography, mosquitoes and flies, general care of the body in the North, first aid, building of shelters such as the Eskimo snow-house, hunting, care of firearms, and means of living off the country.

The U.S. Air Force training covered all these basic practical needs, but the Canadian cookbook was something we had not yet achieved. It is termed the world's most unusual cookbook, which gives detailed information concerning available food sources in the North. About thirty different types of edible plant life found in the Arctic and sub-Arctic are listed, and the book tells how to recognize them and how to prepare them for eating. More than fifty different types of animal life and sea foods are included, ranging from whales to Arctic mice.

The cookbook may never appeal to housewives, who would shudder at the thought of serving a stew of boiled mice and woolly lousewort. This repulsively-

named item is described as the most tasty food plant found in the North. The book isn't concerned with fastidious appetites, its main purpose being to provide information about the plant and animal life that will sustain life. The crew of a Service aircraft forced down in the Arctic might well starve to death, not knowing what edible, sustaining food is to be had for the taking. The RCAF wanted to make sure that this wouldn't happen.

Other books have mentioned that such forms of plant life as lichen, seaweed, Alpine Fleece flower, and willow shoots can be eaten, but few, if any, have given complete instructions concerning their preparations into a tasty dish. The same goes for such items as bats, snakes, sea cucumbers, and walruses, included in the RCAF manual.

The cookbook covers not only edible forms of foodstuffs but lists poisonous types as well, warning against such plants as the water hemlock and Bane berry, and giving a full description of these and other dangerous plants.

Some sea foods, it states, are unwholesome at certain times of the year, and must be avoided. Raw fish, it says, is tastiest if frozen and cut into thin slices.

The manual advises the flyer finding himself living off the country not to be discouraged by the bare appearance of northern vegetation. Food is often hidden, and must be sought out. It states that for years people have thought the North to be a land of plenty, as far as wild forms of foodstuffs are concerned. It

never was, says the manual, and during recent years game animals have been killed at an alarming rate. Finding food material and preparing it for consumption is where the know-how comes in.

The following are typical of the items covered in the manual:

Seaweeds: Should be on your menu whenever possible. Sea lettuce is a pale, lettuce-green type and has the appearance of a piece of crumpled tissue paper. Another species is purple, and it can be used in the same way as the green seaweed. It is black and shiny when dry. Both should be thoroughly washed and may be eaten raw, boiled with a little water to make a thick soup and eaten hot or cold, or used as a thickening for soups and stews of meat or fish. Very gelatinous and forms a jelly when cool.

Dulse can be gathered along the shore between tide marks. It's a large red seaweed, shaped somewhat like a hand, with a palm and long fingerlike fronds. Should be washed, boiled, and used to thicken soups, or dried and eaten raw.

Carrageen moss clings to stones and rocks under water. Has flat, forked stems about two to twelve inches long, of a greenish-purple-brown, or reddish-brown color. Wash and dry in the sun. Can be used to thicken soup or steeped in boiling water to make a jelly.

Lichens: Lichens are low, variously shaped, gray, brown, or black plants that are found throughout Northern Canada and the Arctic. They are edible. These lichens grow on both rocks and soil and are best

collected when moist after rain. Reindeer moss, which is very plentiful, grows in colonies on sandy soil, is grayish and much branched. Can sometimes be gathered from under the snow.

None of the lichens occurring in the North are poisonous, but most contain an acid that is bitter and sometimes nauseous and may cause severe internal irritation if not first extracted by boiling or soaking in water. After boiling or soaking discard the water. Then dry the lichen until brittle, and powder by rubbing between the palms of the hands or by pounding with a stone. If this powder is soaked overnight, it can be boiled to a jelly-like consistency and added to soup or stew.

Dandelion: A weed pest in the south but a potential lifesaver in the polar regions. Both leaves and roots may be eaten raw, and the leaves make fine greens if cooked like spinach.

Sea Cucumbers: These queer-looking animals have the shape of cucumbers. Throw away the insides and scrape away their slimy outer skin. Cut them and cook in a stew or else fry.

Lemming: Lemming are stub-tailed mice that range throughout the Arctic. In winter, they nest on or near the ground, deep in snowdrifts, and you will have to dig for them. In summer, you can find them by overturning flat rocks. You can get them also by hitting them as they scuttle along their runways or by setting snares of very fine wire along the runways. Lemming are constantly preyed upon by shrews, weasels, foxes, and owls.

Fish: All northern fish are edible. All salt-water fish may be eaten raw except the shark. Fresh-water fish in the North may contain parasites that make you sick; so cook them if possible.

Mussels: Most polar mussels are edible. Avoid any that don't shut up tight when you touch them. They are either sick or dead, and unfit for food. Avoid the black mussel, about two inches long, that is attached to rocks by tough treads. This mussel sometimes becomes deadly poisonous in summertime, and cooking does not destroy the poison.

These are but a few of the items covered. The cookbook ranges from recipes using Arctic mice to polar bears and walrus, and, in the case of larger game, provides detailed advice on how to avoid becoming a meal for the animal.

The instruction manual advises aginst eating snow in its natural state. This will cause dehydration of the body instead of relieving thirst, it cautions, and it explains that snow must be thawed first in the palm of the hand, and can be eaten when melted to a slush. About one quart of water a day is needed by a person active in the Arctic.

There are no records that any of our men have tried these Arctic delicacies, but in case any of them get lost this might be a bit of lifesaving information.

In July, 1955, the east-coast and west-coast fleets sailed, fully loaded and manned, on one of the Navy's most difficult tactical missions. The word the Navy had been waiting for had come: breakup was at hand. Each

fleet, the one from Seattle to reach the DEW Line through Bering Sea and the Arctic Ocean, the other coming up the east coast and through Hudson Strait, had a complement of about sixty ships. These included every type of vessel that might possibly be needed for the rough service ahead. There were icebreakers, tugs, repair vessels, victory ships, LST's, and every naval specialty ship for which there might be the slightest use. If any unforeseen difficulty was encountered, the Navy had to be ready to meet it, when it happened, with what they had. Here again, there would be no sending for help, for this mission, as all others had been, was to be made in order to save time. Time in every instance was the one thing of which they were kept continually aware.

The sea lanes, if they were lucky, would be open to the fleets for a scant few ice-free weeks, and a whole year's work might depend upon their making their deliveries and getting out again within this very narrow margin of time. Many months of work had gone into the preparations. But there was always the unexpected in weather and the ice and the sea. To the men aboard the ships it was a dangerous and difficult mission. They were top men in the service, but they were going into waters with their courses largely uncharted, and at continual odds with ice, fogs, and storms. On board were Army Engineers, members of Quartermaster and Chemical Corps, "skin divers," as well as the Transportation Corps units, ready, they hoped, for anything the Arctic might throw at them.

On the east coast, Canada led the way. On June 1, 1955 the HMCS *Labrador* sailed from Halifax with "Intentions proceed Strait of Belle Isle." She carried 25 officers, 13 scientists, and 222 men, a six-month supply of provisions, 3 helicopters and a bewildering amount of special equipment and gear.

HMCS *Labrador* had already established herself in history. In 1954 she became the first naval ship to negotiate the Northwest Passage and to circumnavigate North America. Now, as she set sail from Halifax at 3:00 P.M. A.D.T. (Atlantic Daylight Time), this 269-foot ship with 63-foot beam and 40-foot draft began her second epoch-making cruise. Her primary mission was to serve until the end of September as the senior ship of a task group to service DEW Line sites in the eastern sector in the Foxe Basin area. This project was not alone to deliver personnel, equipment, and supplies, but also to survey hitherto uncharted waters, select landing sites, install navigational control stations, and, most important, guide to safe passage through the hazardous, ice-infested seas and narrow storm-ridden straits the ships comprising her task group.

Eight days later, on June 9, the *Labrador* was in the Strait of Belle Isle. This "channel of the lovely island" was true to its northern type. Visibility dropped to a few hundred yards at the most, with the radar screen pockmarked with as many as fifty icebergs at one time. Two days later loose ice pack was met and the *Labrador* proceeded northward through Davis Strait. On June 15 she entered Hudson Strait, where she met heavy ice as

far as she could see and earnestly set to work breaking through.

Helicopters were continually aloft looking for clear water, and when a channel was sighted to the north, the *Labrador* bucked and crashed her way to reach it, leaving some disgruntled and amazed polar bears in her wake.

Working her way near Salisbury Island a geodesist was flown ashore for an astronomic "fix." Here, as well as during the entire voyage, where rocks or reefs or islands appeared names were given them, and submitted to the U.S. Board on Geographic Names for verification of discovery and approval of name.

Medical treatment was given to several Eskimos in obvious need at Ivugivik on the northwest tip of Quebec Province.

Progress from this point was extremely slow. The ice was under considerable pressure, but with the aid of helicopter reconnaissance, and the thrust of her six sturdy engines, and favorable tidal streams, the *Labrador* reached Coral Harbor, on Southampton Island, on June 28. There, an unbroken sheet of ice covered the inner and outer harbors. Little by little, with obstinate determination, the ship slowly chewed great arcs in the ice and forced her way into the anchorage.

Within two days, with favorable winds and currents assisting the *Labrador,* the harbor was sufficiently clear of ice for landing parties to proceed in preparing the beach and setting up navigational beacons.

The *Labrador* pulled out of Coral Harbor on July

3, about the same time the supply fleets were leaving their berths in the United States, and chunked her way into Foxe Channel, and by the seventh was near Cape Fisher, on the east coast of Southampton Island.

Cape Fisher had been selected as one of the eastern key points for navigational control, with a radar, radio, and meteorological station installed and equipped and manned from the *Labrador*. Due to ice conditions the use of boats was out of the question, so helicopters handled the chore.

The first flight took off from the deck at 8:30 A.M. on July 8, and from then on the 'copters were in constant action, loading, taking off, unloading on the shore, and returning for more. The construction party was the first ashore, then in went the tents, the prefabricated shelter for the technical equipment, then the tide gauge, more building materials, generators, fuel, aerial mast, the needed scientific and electronic equipment, the men to service the station, and finally the supply of food. This was all accomplished from where the *Labrador* "lay to," three or four miles offshore in heavy ice. The job was completed at 5:00 P.M. on the ninth, the following day. It had taken 19.9 flying hours and involved a total lift of 28,640 pounds and 290 man-hours on the beach.

From Cape Fisher the *Labrador* moved on to Cape Enauolik, on Baffin Island, on the opposite side of Foxe Channel, for a second installation. These navigational posts had an important part to play during the coming months, for the data on soundings showing water depths

were scant on existing charts. The two stations were manned and operated by naval personnel, and these men kept their beacons working without fail. The complete isolation of the eight men at each post, combined with the discomfort of the living conditions, presented the starkest sort of existence.

Just as the *Labrador* had finished at Enauolik, a radio message was received that Cape Fisher was in trouble. Back she went, clawing through ice to find the post at Cape Fisher a shambles. A day or two before, a storm had released its lashing fury and flattened man's flimsy efforts to stake a claim on Arctic land. The tents were ripped and down, the aerial tower was down, and the post had all to be done over.

The tents were brought aboard, mended and strengthened, and returned to the post. The aerial was rebuilt and reinforced, and with Cape Fisher once more in operation and secure, the *Labrador* again turned her bow northward.

With the supply fleet expected within the next month, the *Labrador* had her work cut out for her. She must establish a route for entrance into the Arctic.

As this sturdy little ship went to work, the whole southern portion of the Foxe Basin was packed with ice. She hammered and pounded in almost frustrated frenzy, but her determination was as strong as her heritage. At times demolition crews worked ahead with high explosives, and finally when she reached one of the locations where a main unloading point was to be established, her frogmen, or "madmen" as they were called,

went to work. In their underwater suits they located rocks and reefs, set their explosive charges, and cleared channels of obstructions so the Navy landing craft could make the beach.

All this and weather, too. Wind, snow, rain, and sleet lashed with the fury of the devil, and always there was the cold. It was the hardest, toughest sort of work.

From the shore side the crews of the Foundation Company, the contractor for the Eastern DEW Line sector, had been doing their share of making ready with the equipment that had been flown in to them. They had worked equally as hard in preparing the beach approaches. On the day that the two met, when the *Labrador* made the shore, the weather loosened up and actually smiled. A party from the *Labrador* went ashore and challenged a team from the Foundation Company crew to a softball game. It was a well-fought game, and both teams battled to the final out. Unbelievably, the sailormen whipped the landlubbers by a very close score of 24 to 23. There probably would have been more scoring if it hadn't been for the slippery condition around second base. Also, the outfield was a bit rugged with two ponds in center and the rim of a lake cutting into left field. The next day the weather clamped down again and the landsmen never had an opportunity for a re-match. Anyway, the *Labrador* had to go back to work.

The tour of the Foxe Basin was hampered now by walrus almost more than ice. These families insisted upon showing their inherent right to this ice and water

by swimming in front of the ship directly in its path. There was nothing to do but to alter course or wait until the walrus changed their minds. One four-hour watch reported fifty-two walrus in pairs or small groups defying the right of the *Labrador* to share swimming privileges in their water.

When the *Labrador* returned to Coral Harbor, she found the first U. S. Navy ship, the *Pursuit,* and the two set sail for Chesterfield Inlet, at the northwest corner of Hudson Bay. It was a rough trip. A forty-five-knot gale literally upended the sea in the shallow waters of the bay. The log report read: "We rolled and pitched." Beautifully succinct, and a gem of understatement.

The two ships, with their hydrographic parties taking over, surveyed beaches and approaches. Their main concern was the "big load" on its way up the east coast. Everything insofar as it was physically possible to make it so, must be ready. Time would be short, and there would be none to waste in correcting mistakes or in taking care of details which should have been anticipated.

By the end of July conditions were such that the project looked all but impossible. Weather had been foul to rank, and the Foxe Basin ice was open only to the icebreakers and explosives. The North simply would not give in! The *Labrador* fought her way to break up jams and to cut patterns that might loosen the hold, but perverse winds held the ice in a solid mass.

This was the gamble the Navy had taken. If the

channels and basins cleared of ice, they could be reasonably sure of landing their cargoes safely. If not, they could do no more than to return and either wait to try again next year, or to have the airlift continue throughout the year.

August, however, was gentler. Quick thaws and a steady hard wind out of the northwest jarred the ice and helped clear the way. The situation was far from good, but it was decided to make the try to get through.

The convoy was ready. The carefully prepared charts were delivered to the captain of each ship along with thorough briefing. It was a gray, sullen day in August when the group started through. The *Labrador* was in the lead of one column of ships, and the U. S. Coast Guard icebreaker, *Edisto,* led the other. The following week was logged as a "nightmare." Shortly before midnight the convoy halted. "Darkness and heavy ice." By six o'clock in the morning the icebreakers were busy chewing the merchant ships out of the ice that had formed during the night. The next few days were logged:

"Icebreaker got under way at 0600. Column moving by 0700. Ships repeatedly got stuck and had to be cut out. Stopped for night at 2200, after which rounded up stragglers. Made good . . . 8.9 miles. Under way in fog at 0515. Stragglers rounded up and ships under way in small groups. Remained under way during night to maintain positions against current of approximately 4 knots. Made good . . . 8.1 miles."

Crashing through the heavy ice which groaned and

screamed in protest, the convoys beat their way foot by foot. The ships sustained superficial damage but fortunately nothing serious, and they kept on going. They finally reached the first landing site. The shore crews were ready and landing craft began their work. Before full tempo was reached, however, the "madmen" once more were called upon to go below the surface and set charges to blow up boulders that troubled the landing-craft skippers. The unloading continued on a round-the-clock basis.

This was a "breather" for the *Labrador*. She lay offshore and sort of licked her wounds and rested while the convoy lightered and moved tons of equipment ashore.

When this delivery was finished they moved on. More ships arrived and those which had discharged their cargoes returned to the "outside." By early September the U. S. fleets were on their way home. But the game little *Labrador* still had work to do.

Late in the month she pitched and rolled her way northward into the jaws of a snarling gale. Although this one relatively small sector of the DEW Line had been successfully serviced with some 30,000 tons split among the several sites, there was another year coming up. So the *Labrador* was searching out new data for better charts. Such ships as the *Labrador* not only performed the unparalleled service of clearing channels and opening lanes through the ice, but also added greatly to hydrographic and oceanographic knowledge of the entire Arctic area.

At the last the *Labrador* was dented, dulled, but undaunted. As the Arctic winter began to growl in earnest, she worked her way eastward through Hudson Strait, and radioed her intentions to return to her home berth. She also added the weather report: "Snow . . . wind 55 knots . . . whole gale . . . temperature 32."

A rugged finish to a rugged job with every credit shared with the rugged men who sailed with her.

THE SEALIFT

CHAPTER SEVEN

WHILE THE LABRADOR WAS SLICING and slugging her way through the straits and clearing bays down east, the western Navy convoy of about sixty ships headed north from Seattle. It was practically a duplicate of the eastern convoy. One would serve the western half of the Line, the other the eastern. In this way they hoped to be able to reach every landing site and discharge their essential cargoes before winter would freeze them in.

By comparison it would seem that the eastern ships were going to have an easier time in reaching their objectives, because some of the eastern waters were opened to commercial shipping during the summer. Churchill, Manitoba, is one of the world's greatest grain ports, and for the few open weeks of summer the grain-freighters move millions of bushels of Canada's wheat across Hudson Bay, out through Hudson Strait

and across the Atlantic. This traffic keeps the Strait clear and at least offers an easy entry into the waters of the DEW Line. This gave the eastern convoy that much of a head start, but after that there was not much choice.

The advantage to the eastern convoy was marked by that distance of the established freight lane. The western convoy had no such help, because in the waters north of Alaska and the Northwest Territories there was no commercial reason whatever for opening shipping lanes.

One other reason why the eastern convoy might be favored was that it was at about 60° north latitude, and the western ships were at 70°, almost 1,000 miles farther north. However, both the east and west convoys were well prepared for a rough go.

This western convoy, which left Seattle early in July, contained at least one of practically every type of craft the Navy could float except combat ships. They went prepared for anything the Arctic might throw at them. There were icebreakers, tugs, repair vessels, LST's, Victory ships, every type of lighter craft for unloading operations, and a few others. And the convoy took with them a couple of thousand Army men who had been specially trained for this job at Ft. Eustis, Virginia, and assigned to help in the unloading. Equipped and prepared to overcome every conceivable situation—it was rumored that the chief explorer decided at the last moment to take along an Egyptologist as, he explained, "You never know what you're

going to find around the Pole"—the convoy plowed its way north.

Twenty-eight hundred cold, miserable miles later they passed the Diomede Islands and made their first freight stop at Pt. Barrow. The Bering Strait had been clear of ice, and the forecast eastward into the Beaufort Sea, after making the turn at the tip of Alaska, was for clear sailing and fair weather.

The unloading at Pt. Barrow presented no great difficulty. Freight put ashore here would ultimately be delivered to the sites along the Alaska experimental line by "cat" train as soon as freeze-up arrived. Supplying the Alaska line had not offered any too difficult problems.

Time was not wasted. There were still a couple of thousand miles of DEW Line stretched eastward that were waiting for attention. As soon as the last crate was landed at Pt. Barrow, the convoy strung out and headed eastward.

There is probably nothing more perverse or unpredictable than Arctic weather. A change of the wind and across what had been open water, came slushy ice fields that normally blew offshore in summer. They headed south and surrounded, shoved, mauled, and threatened to crush every ship in a relentless grip of ice that moved and surged almost as though it were alive. A propeller was lost, a few rudders were torn off. The disabled ships had to be towed out before they were forced to shore and crushed. The others fought through. Icebreakers cut swaths, and their wakes immediately filled with

more ice. The wind swept down from the north and every ship was tried to its utmost to keep offshore to avoid being pounded to death.

When the wind dropped, the ice stopped, lay there, and froze tight. But this was something the icebreakers could cope with. Although hulls were bruised and dented, there was no more serious damage as the heavy, powerful icebreakers bludgeoned a path, and the convoy crawled on, mile by hard-won mile. And each mile meant fewer in the more than a thousand yet to go.

"We're getting there, boys," said one of the seamen after a good day's run had chalked up nearly ten miles progress.

"We're making it all right," an Army corporal observed, "but don't forget, bud, we've got to unmake every frozen inch before we get back to civilization. And before we can even start back, we've got to chomp our way the full length of this icebox and get unloaded. 'Join the Navy and see the World,' that's what they do to you guys. Me, I'll stay in the Army, the Army don't send you to places like this."

There were days that were good, some indifferent, and others that they wished had been left off the calendar. About half the time the weather was "not too bad."

As the winds went, so went the huge ice floes, and as the tides and currents went, so moved the gigantic ice islands. Ice floes were like oversized icebergs, ponderous in size, and before a gale wind a mere nudge from them would be enough to crush a steel hull. These

free-for-all menaces seemed to be everywhere, and were a constant danger. The ice islands were massive tabular floes of great size and between 100- and 200-feet thick. These floating slabs of ice which have been judged to be perhaps 2,000 years old, wend their lethal way along the polar currents. There are several of them in existence, miles in size, and never presenting a sure opening for navigation. These phenomena stay frozen and float with the elliptical currents about the North Pole.

The convoy cautiously and doggedly made its way. One by one the radar locations were serviced. The ground crews, like those in the eastern sector, had worked long and hard to prepare beach approaches for the safe unloading of cargo. With the bulldozers and tractors that had been dropped by the airlift they were able to smooth and bank the gravel beaches, and to build roads of a sort to the safer higher levels for the cargo storage. The land side was in fairly good shape for the convoy's arrival. The one thing, however, the shore crews had not been able to handle was the underwater channel approaches for the ships.

There was hardly a landing where the convoy's frogmen were not in the water more than they were out of it. Huge underwater boulders, obstructions, and hidden reefs presented a wide and thoroughly effective barrier to any sort of unloading from the convoy's ships. So the Navy demolition experts donned their rubber "skin diving" suits and plunged into the icy water. They searched out the obstructions, placed the explosive charges, and literally blasted a way to the shore.

The LST's opened their great maws and disgorged the heavy stuff—cranes, big generators, storage tanks, bigger bulldozers than they already had ashore, diesel engines, road building machinery, and more. The LCM's (mechanized landing craft), LCV's (utility landing craft), DUKW's (amphibious trucks), and the World War II LVT's (landing vehicle tracked), and the new giant sixty-ton amphibious BARC which could ferry heavy cargoes from ship to shore over distances up to several miles, took over the rest of the chore of getting crates of electronic equipment ashore. Along with the crates went cases and drums of food, supplies, knocked-down buildings, gasoline, fuel oil, lubricants, spare parts, steel for towers, plastic covers for the radar installations, paint, wire, every type of tool and electrical and mechanical need. Literally everything from a needle to a thousand-ton crane! And doing the stevedoring in around-the-clock shifts were the hundreds of Army troops who slogged and slushed through soggy swampy shore or skidded their way over the marble-smooth gravel.

Again, it was time that called the turns. Every day or hour lost at sea because of ice, fog, or in battling for existence against one of the unpredictable Arctic summer hurricanes, added man-hours on the beach to make up the deficit. Almost half the time at sea was lost to these fogs and storms. The men had already seen the destructive power of wind-driven floe ice.

"Ice!" an Army man was telling a site engineer at one of the unloading stops. "We'd been creeping along

in this fog so thick that it was almost like walking through the inside of a frozen cream puff. You could hear the ice scraping the sides, and when a big chunk would nudge us it was like a jolt in the jaw. And the wind! It's not like any other wind anywhere I've ever been. Most winds, no matter how hard they are, blow around you or past you. But not up here. This wind is like a solid or something. It's got substance, like you couldn't go through it. It's rough, and when it hits you it hurts."

He stopped and lighted a cigarette, looked out at the ship he was talking about, and said, "Then we stopped. Now I know this sounds funny, but you could almost feel that ice crushing the ship. It was like being inside of, well, maybe inside of a great big ball, and a huge fist began to squeeze and squeeze, and there you are inside, and you can't do a thing about it. Most helpless feeling I ever had, and I don't scare easy. Well, that's the way it was. We weren't moving any more. There was only the wind, and that squeeze, squeeze, squeeze."

The soldier took a couple of drags from his cigarette. "Then she cracked. Like an egg. Stove in the plates and flooded the engine room. Then just as if that's all it wanted to do, the wind whipped around, the fog lifted, and a repair ship got to us."

He looked at the engineer and smiled, tossed his cigarette away and stood up. "Well, back to it, pal. When we get your stuff unloaded we got a few more RFD stops to make."

"That training we got back there in Virginia was all

right," one of the boys said. "It sure helped a lot. But there's nobody that can make mud as sloppy and greasy slick, or gravel that's like marbles, or water that's as cold as they got it up here. They tried to make it tough when they were seasoning us up, but that wasn't even a boy's size sample of what this country's really like. Up here it's for real, and I mean real!"

No part of the job was easy, and it was all work, hard, tedious, and tiring, but it had to be done. What time the men had off, they slept. They were usually so dog-tired that even if there had been recreation places, they would have chosen to catch up on sleep. So they got all the rest they could to be ready for the next round of landing chores. The men knew that if they didn't finish this delivery trip there'd be trouble. Not for them, for they could be flown out. But there would be considerable doubt as to the safety of the sixty-odd Navy ships at the mercy of the winter.

They plodded on. Day and night in ceaseless effort. Occasionally the Arctic turned on the charm of a spring day, but these glimpses of nice weather were rare. However, good weather or no, the demands of supplying the DEW Line with essential equipment were stern and unrelenting.

One thing the men did well besides work was eat. The chow was the very best, and plentiful. Nor were they selfish with it. One noon, just at messtime, a couple of sailors spotted a lone polar bear standing forlornly on an ice floe watching the ship.

"Poor fellow," one of the men said. "He must have

it tough finding enough to eat. And by the size of him it must take plenty to fill him up. Tell you what, let's go down to the galley and see what's for garbage, and maybe help the guy out with a square meal."

"Be okay," his friend answered, "if he just happens to like garbage."

"We've been for days along here and never seen a thing alive, not even an Eskimo, and think of how much trouble he has getting a feed."

"By the size of him he hasn't had too much trouble. Bet he weighs a thousand pounds. Eats fish. All he has to do is jump in and get all he wants. Better let him alone. I don't like bears."

"No, I'm going to see what I can do. Nothing to be afraid of."

"Something tells me you're making a mistake. Polar bears been getting along all right up to now without the Navy."

Nevertheless the soft-hearted sailor went below and was soon back on deck with a supply of C-rations and a few other delicacies. He succeeded in throwing these choice bits to where the bear could reach them. "See!" the sailor said to his still doubtful friend. "Look at him eat. I tell you the guy was starving."

Soon the feast was over, and the sailors stared at the now fully interested and expectant bear. It was an enormous animal, and like all bears was highly inquisitive and absolutely fearless. The ice floe on which he stood was moving slowly toward the ship. It wasn't long before the chunk of ice reached the ship. As it did, the

bear made a lunge and came aboard, and started walking toward his generous friends. The two sailors disappeared down the companionway. The bear sat at the top and sniffed the savory smells from below.

"What are we going to do?" the generous sailor asked.

"Don't look at me," his friend answered. "He's your bear, not mine. I told you to mind your own business. But no, you got to go getting palsy-walsy with one of the toughest animals in the world."

The problem was how to get rid of this burly intruder.

The sailors called for help. They could have shot the bear and charged it off to self-defense, but instead they loosed the full force of a fire hose upon him. For the next few minutes the deck was a dizzy whirl with the maddest polar bear in the Arctic trying to fight back at the blasting charge of the water. Finally he gave up and in one bouncing lunge was back over the side into the safety of his ocean. Once back on his ice floe he sat and stared at the ship.

"Probably cussing you out in Polar Bear for inviting him to dinner and then treating him like that. I told you to let him alone."

The other sailor shook his head. "Too bad," he said. "And I'll bet the poor guy is still hungry."

Stops were made, freight put ashore, and the course continued. Some of the radar positions were so located that there were no beaches for landings. Shores of sheer rock cliffs prevented any sort of unloading. In these in-

stances the cargoes were put ashore sometimes miles farther on where beaches permitted the craft to make the shore. Roads had already been cleared and dragged by the machines that had been delivered by the airlift. At these points no time was lost. The shore crews helped in unloading from the ships and reloading the supplies on trucks, or making them ready to be carried in by helicopter, or hauled by "cat" train, whichever best met the requirements. Even to the last stop there was never an easy, simple way of getting the supplies where they were needed. Each landing called for every bit of ingenuity and experience the men could summon.

Every practicable kind of transportation was used to support the major efforts of the Air Force and the Navy. The Northern Construction Company with its barge facilities fed freight from a railhead at Waterways, Alberta, Canada, down the Mackenzie River to Aklavik, some 1,500 wilderness miles. Sometimes there was treacherous water, sometimes portages, one at least fourteen miles long around rapids, over which such cargoes as a sea-going tug were hauled on rollers.

Such freight reaching Aklavik, an Eskimo trading settlement on the Mackenzie Delta, was stored for redisposition along the coastal lines by boat and by "cat" train and by air.

Alaska too was taking part in this over-all logistic plan. Alaska Freight Lines opened trails for overland transportation and by unique utilization of specialized equipment hauled approximately 1,100 tons of petroleum products from Fairbanks to the Arctic coast. And

by this same means thousands of tons of cement and steel bar were hauled north. The heavy-duty tractor-trailer units are operated continuously back and forth in this third augmentation of constant supply lines. At no time, winter or summer, can this supply be stopped.

In all, during that summer of 1955, more than 200,000 tons of cargo was landed at the DEW Line by the efforts of the Navy, plus the thousands of Army men in practical support. Besides that, the sturdy barges on the Mackenzie River transported another 8,000 tons into the Arctic; 1,100 tons arrived via Alaska. In total, approximately 209,100 tons reached the Arctic beaches. And all within the scant period of less than two months of open navigable water.

For those who enjoy putting things end-to-end, or making familiar comparisons, here are merely two. If the oil drums delivered that summer to the DEW Line were laid end-to-end, they would extend 180 miles. The gravel that was used in making the landing strips at the sites would make a two-lane highway, twelve inches thick, from New York to San Francisco. These are commonplace examples showing the tremendous scope of the entire undertaking, for all the other supplies and equipment could offer similar comparisons, equally as high, wide, and long. And that is only the beginning, because the oil, the gravel, and every type of material used must continue to be delivered in mountainous quantities.

As to the personnel, from the time that the DEW Line project had been activated and during the process

of its development, representatives of the Canadian and United States Armed Services and other agencies totaling an estimated 9,000 persons, were moved, mostly by air however, to and from the work areas. All in all it was an unprecedented achievement.

As the Arctic winter flexed its muscles and bared its claws, the naval convoys, both the east and the west, limped homeward. They had learned valuable lessons, and would profit by them, for there was another summer coming with more thousands of tons to deliver, and other summers after that. The service of the DEW Line was a constant, continuing process. The ships were safely berthed in October, licking their wounds after the first round of their battle with the North, and proud of the tremendous undertaking they had successfully accomplished. Every piece of equipment, every ton of supply had been safely delivered at the scheduled time and to the right place.

BUILDING THE LINE

CHAPTER EIGHT

As the convoys had neared each landing, there was a sort of holiday expectancy among the men ashore. They had been kept well posted, by radio, as to when the ships might arrive, and this was plenty of cause for excitement. Seeing new faces, hearing new voices, and batting a bit of breeze was like a trip "outside," or seeing folks from home. But all too soon after the ships arrived and the initial excitement reached the peak of backslapping welcome, the tempo leveled off to the slogging rhythm of plain hard work. There it remained until the unloading chores were done.

Nor were there any particular farewell ceremonies. The stevedoring Army men were eager to hit the sack and be ready for the next landing; the Navy men knew there was no time to waste in formal good-bys. The men on shore had been steadily preparing for this moment for six months or more, so they were equally eager

to get to the business of completing the permanent location.

Soon strange-looking settlements began to show along the rim of the continent. Groups of tents gave way to the sturdier and more practical modular structures that had proved to be so successful along the Alaska test line. In the Canadian sectors, however, the "cat" train delivery system of already assembled modules could seldom be used, for the rugged mountain terrain in the east barred this sort of transportation. In most cases, therefore, the modules were assembled after they were landed. So that the work might be carried on with greater ease and relative comfort, tentlike coverings, heated, were supplied where the assembling could be done. Similar tents were used for hangar and garage purposes for repairing and servicing planes, trucks, tractors, and the like.

The modules took shape, identical in form and size, the only difference being in the number and placement of doors and windows. The insides, however, were individually arranged. Some were prepared to function as electronic laboratories, some were sleeping and living quarters, others housed generators or power plants. Then there were kitchens, dining rooms, recreation rooms, tool shops, laundries, storerooms. In fact, there was every element of a completely self-contained community for the care, service, and maintenance of the radar-radio installations. The purpose of each site, whether it was a Main Station, an Auxiliary, or a Gap-Filler, determined the types and numbers of the mod-

ular units to be assembled.

Certain basic factors had been taken into consideration in designing these modules. First, since they were to be living quarters, they had to be comfortable. They had to be so planned and arranged as to meet the personal and equipment requirements of the men. They had to be resistant to wind, cold, storm, fire, and deterioration. Also they had to be economical to manufacture, easy to transport, and simple to assemble. All these requirements the modules met most satisfactorily.

When the modules, with each panel prefabricated and treated with fire-resistant paint, were ready for placement on their foundations, aligned and oriented in the direction of the prevailing winds, the spaces between them were sealed and filled with fire-retarding insulation. Fusible alarm wiring was used throughout and each had automatic carbon dioxide and sprinkler systems with the piping inside and well insulated against freezing. Every possible precaution was taken not only to prevent fires but also to furnish each location with proper equipment for fighting them.

The problem of heating these settlements was neatly met by the use of the exhausts of the diesel-generator units. This waste heat, which otherwise would be futilely dissipated into the Arctic air, is captured by heat-exchangers from the exhausts and jackets of the engines and used in a thoroughly practical hot-water heating system. Not only does this virtually eliminate the fire hazard, but of almost equal importance it reduces measurably the amount of fuel oil used. And fuel oil is

one of the urgent necessities and greatest items of expense in the Arctic.

In the sections housing the delicate electronic equipment, the walls, ceilings, floors, doors, and windows are shielded with copper screening to prevent the slightest deviation from accurate operation because of magnetic influences and storms. In these modular "villages" things are more functional than artistic. The prefabrication of every detail of each complete site was so complete that no time was lost in milling, sizing, adjusting, or remaking a single piece. The electrical equipment was pre-assembled as far as practical, so that complete units could be joined, plugged in, and put in operation with no tedious wiring problems to meet. Every piece, from a length of pipe to the complete unit, had been made with such precision that it fitted accurately into its proper space.

This form of assembly was general throughout the Line, and no matter from which of the hundreds of contract manufacturers any specific item was received, it fit its function without adjustment. This also simplified repairs. From a single screw to a complete assembly, the units were fully replaceable. Furthermore, complete testing had already been done before the part was shipped. For these reasons, the radar and radio installations were operable upon assembly, and their maintenance has been reduced to an absolute minimum.

Now and then groups of Eskimos gathered to stare at these strange goings-on in their land. They watched the pouring of concrete and the setting of the antennae

bases. They were fascinated as riggers built the great skeleton steel towers and frameworks. They clucked and shook their heads in amazement as the men climbed over the labyrinth of structures, and they moaned in disbelief when the huge plastic dome was fitted into place, piece by piece, to shield and protect the miracle of radar which would go on inside. They were like children in a fairyland, hardly believing what they saw.

Eskimos are kindly, friendly folk. They live the most spartan existence in their constant search for food. Notwithstanding their tenuous hold on life, they are one of the happiest people on earth. They may be hungry, cold, or even near death, but there is always a smile very close to the surface. They are also apt students. The very fact that they live by their own ingenuity, even to the making of their own weapons to get their food and the fur for the clothes they wear, makes them quick to learn and to adapt.

Eskimos are co-operative and can be excellent workers. Before long their interest, curiosity, and willingness to help made them eager to take part in this still incomprehensible activity. They wanted work, and they got it. The one thing they couldn't understand was the meaning of the word "job." Work was work, yes, but to be expected to do a cerain thing for a certain time for a certain amount of money meant nothing to them at all. For their way of living they worked or not as necessity demanded. Money meant nothing.

Canada is proud of her Eskimos and rightfully wants no outside interference with her very intelligent pro-

gram of caring for them. Therefore, when it became obvious that the Eskimos would be willing workers on the DEW Line locations, the Canadian Government of Northern Affairs, which administers the affairs of the wilderness Indians and the Eskimos, made it quite clear that there was to be no interference whatever with the Eskimos' normal way of living, nor was there to be any exploitation of them. These people, they explained firmly, were Canadian Eskimos, and Canada planned to have them stay that way. Eskimos, living as Eskimos have always lived, will remain a proud and valiant race with intelligent co-operative help. Canada will never allow her natives to become serfs or charges through assimilation if she can possibly prevent it.

Eskimos cannot be hired on the DEW Line without the permission of the Northern Affairs Department and a full explanation given of the type of work they will be expected to do. They are not menials or servants. They are a proud people in their own land. The result is a splendid understanding of equality among all the men working on the Line. There is no segregation, favoritism, or sense of superiority of one human over another. Up there in the Arctic there is a common bond in one world.

One young Eskimo edged closer and closer to the activity day by day. Finally he was near enough to take part. Some geophysicists were working on the problem of testing the breaking point of ice thicknesses. One of them offered the Eskimo the job of cutting holes through ice for measurement. The Eskimo eagerly

set to work, cut a hole through the heavy thick blue ice, then calmly sat down beside it, waiting expectantly.

The scientist quickly made his measurement and jotted it down; then he went on to a different spot and indicated he wanted another hole cut. The Eskimo didn't move. He merely sat and stared in utter surprise at the white man, and pointed emphatically at the hole he had just cut. The scientist became positive, but the Eskimo wouldn't budge.

A Canadian came by, and sensing the predicament, he walked over and exchanged a few words with the squatting Eskimo. Then he laughed and went to the white man.

"He thinks you're crazy," he said. "He wants to know why, when you've already got one good hole you want another one cut. One hole to fish through at a time is enough, he says. So, better get yourself a piece of fish line and a hook and jiggle it down there in the hole for a bit if you ever expect him to cut another. Up here you do things their way."

One other young Eskimo, an excellent worker, was as busy as could be until for no apparent reason he suddenly stopped, laid down his tools, and took off. He was gone for several days, and when he returned he explained simply that he had been walrus hunting. He had done exactly what he wanted to do at the moment. When the word "job" was explained to him, he in turn explained even more patiently that he neither needed nor wanted a job. He and his family and his ancestors had survived without jobs. He would continue

to work, he said, but if he wanted to hunt, he would hunt. He only worked because he wanted to. Then he cheerfully went back to his "job."

Another Eskimo, noted for his unerring sense of direction was hired as a guide. On his first trip he drove his dog team ahead of a "cat" train across tundra, without landmarks or compass to guide him. It was a 130-mile trip, and he reached his objective in two days. A plane checked his trail, and found that at no time had he been more than four degrees off a straight route. Such feats, commonplace to them, are phenomenal to those who may never fully understand the almost mystical senses of these wonderful primitive people.

Still another Eskimo became lonesome. He liked living in the modular house. He liked the big meals they served him. But he had no one to visit with, no one who could understand him; so he insisted on having someone near and dear to him for company. At first the other men showed some resentment over his choice of a bunkmate, but the Department of Northern Affairs said if that was what he wanted, that is what he should have. After all, a malemute puppy didn't cause too much disturbance, and it made the young Eskimo lad happy and content.

If the Eskimos needed an occasional bit of "pampering," the men from the States got no such breaks. Broken in as best they could be in the synthetic frigidity of their training bases, they still had personal adjustments to make to actual Arctic living.

Sheer boredom was one of the great hazards of

such communal living. There was no place to go, and notwithstanding that every practical form of recreation was furnished, there were hours when time hung in a vacuum. The phlegmatic Eskimo merely dug up a grin from a backlog of some thousands of years' heritage of solitary living as he watched the volatile white man's nerves fray at the edges merely because of the lack of entertainment. It was understandable, for how could the white man be conditioned for this life, either by experience or physical preparation.

On this account the men are closely watched as to their frame of mind, and their tours of duty are rotated at such frequent periods that no stay is long enough to cause severe reaction. No two men react alike, some can take it longer than others, but long or short the reports from them came out about the same—"Believe me, it's no fun living in the Arctic. It's tough . . . real tough."

But the work goes on, steadily and surely. Every day sees new changes and improvement in the DEW Line. The original rubber domes for the radar shields were first replaced by prefabricated and fitted plastic units. A new nylon shield is now in use on some of the sites. It is furnished in panels and zippered inside to make an air and weatherproof protection.

As the modules take on the form of permanence, very little is omitted for the comfort of the men. Kitchens are of stainless steel, the plumbing is modern. Running water, electric lights, hobby rooms with special attention to the needs of amateur photographers are

provided. The game rooms cover everything from cribbage to ping-pong. There are movies. And the food and the beds are the best. But no matter how cozy, comfortable, and appealing they make things inside, outside is always the North, and dancing partners are a long way off.

At some locations near trading posts, young settlements have begun to spring up. And some of the Eskimos are moving into houses, and schools and hospitals are being established. The Department of Northern Affairs in Canada welcomes this activity for their native charges, but is ever on the alert to see that the Eskimo is extended equal courtesy and opportunity.

The operation of the DEW Line is also opening new avenues for the geophysicist, the meteorologist, and the geologist. These scientists and others are already deep in research to learn the secrets that may be held above, in, and below the eternal Arctic ice.

THE LINE GOES TO SEA

CHAPTER NINE

DURING THE FALL AND WINTER OF 1955 the freeze-up again made the airlift the only means of supply for the DEW Line. At the same time the wharf warehouses on the east and west coasts were again being loaded for another sealift attempt the following summer.

So far, since the beginning of Project 572 in Alaska, there had been no formal publicity about this fabulous undertaking, and the public of the United States and Canada were kept as unaware as possible of the building activity going on along the Arctic Circle. The DEW Line was a fully classified undertaking, and very little actual detail was issued for news distribution without the closest scrutiny of the Western Electric Company, the Air Force, and Canada. It was kept as a completely top-secret enterprise.

When the Alaska sector had been tested and had

passed the experimental stage, and the Canadian stretch of the entire Line marked and building begun, it was decided that the two countries could be told at least some of the facts of this new northern lifeline.

In April of 1956, the U. S. Air Force flew a group of thirty reporters on a five-day tour of the Line. Prior to the flight, the newsmen went through detailed briefings by officers of the Air Force, the Army, the Navy, and by members of the Western Electric Company. These briefings were very thorough, and covered the interesting newsworthy facets of the DEW Line.

The trip itself is one that the reporters will never forget. When they returned, thirty splendid articles appeared. The climate, the food, the flight, the Eskimos, the Arctic regions were expertly and graphically described. But the DEW Line, except for the basic explanation of its reason for being, remained almost as much of a secret as ever.

Shortly after these articles had appeared, an editor and a friend of his were talking about this DEW Line publicity.

"It figures," the editor said. "Those were top men and good writers, but the briefings they went through were not so much to show them what to use, but to tell them what they couldn't write. There's so much about the DEW Line that can't be told or written that they were limited almost to weather reports and human interest. It will always be a highly classified deal. You can't describe the type of radar or radio equipment, you can't tell where the sites are located, what they

look like, or what they actually do. You can't tell what they consist of, how they are manned or by whom, or anything about the actual details of their construction."

"Security reasons?" his friend asked.

The editor nodded.

"You mean this is all being kept secret from the Russians?"

The editor shrugged. "They probably know where these sites are. A friend of mine who's pretty well up on radar said that the Soviets could fly electronically equipped planes along the length of the Line and spot every location, and they probably have."

"Then why this classification or secrecy?"

"Because of the equipment itself, probably. We don't know how advanced these setups of ours are, and we're just not being told. I'm convinced that the scientists who are responsible for the Line have come up with some pretty keen ideas on electronics, and the less it's tossed about the better off we are. Maybe the Russians have what we have or more. We don't know, but it's just normal wisdom to keep our mouths shut about something that is as important to our national security as this DEW Line is."

"I'll buy that," said his friend, "but if you were going to publish a story about the DEW Line, what would you do?"

"Probably the best thing I could do as a newspaper man would be to tell my readers in as serious and emphatic a way as I knew how, the importance of the early warning system to our national safety, and ex-

plain in as much detail as possible how the DEW Line is the key link in our system of continental air defense. We aren't building a line of radar stations to keep some men and factories busy. No, sir, this business is for keeps. And we'd better hope it works . . . no matter what it costs."

"You're not being an alarmist, are you?"

"Are you out of your mind?" The editor leaned forward and spoke with grim conviction. "You hear a lot about the plight of the Russian people, the poor, downtrodden proletariat, and their lack of farm machinery and equipment and stuff. But how about the Soviet air power, and what they are doing in the way of missiles? Do you know much about what they've been doing in those lines?"

His friend shook his head.

"Well, then, I'll tell you." The editor reached in the drawer of his desk and took out a notebook, flicked past a few pages, and briefly ran down some of the data on Soviet air power and what they had been doing since the end of World War II.

When he finished, he looked steadily at his friend for a moment, then continued. "Now, get this. The startling thing is not so much that they are producing effective aircraft, but that they are building these things in great numbers, and at an alarming rate. Now, any one of their bomber units penetrating our defenses would be capable of striking crippling or annihilating blows with nuclear or thermonuclear weapons. And don't fool yourself, my friend, they've got them all,

and working on more. So, why should they worry whether the farmers have got machinery so long as they are building up an air force which they figure can whip the world?"

The editor smiled at his friend, "Yes," he continued, "we'd better hope that the DEW Line works, and from all I know, it does. Because those four hours of warning may be just what we'll need to keep on living if those boys over on the other side ever figure they've got enough to take a chance."

The editor slipped his notebook back into the desk drawer and closed it.

"Gives a fellow something to think about, doesn't it?" he commented.

His friend nodded his head slowly. "Plenty," he said. "It's plenty to think about. And as you say, it had better work, all the way around."

France thought they had the perfect answer to their national defense in the Maginot Line when they built the modern counterpart of the Great Wall of China, and it cost them plenty. And what did the Germans do but pay no attention to it and go over, around, and all but under it. So what would happen when we had this solid 3,000-mile fence of radar across the northern rim of the continent, deep enough and holeproof enough to prevent attackers flying over, through, or under it, if attackers could skirt right around the ends of it and come at either us or Canada from the sides? If all the DEW Line could do was to warn us of the over-the-Pole invasions, we would be fatally vulnerable.

It was thoroughly evident from the very beginning, when the Summer Study Group of 1952 gathered to consider the system, that contiguous elements were essential for complete protection. The Arctic stretch of the radar fence was obviously the first and most difficult link to build. So while the planning was going forward for Project 572, discussions were already taking place as to the feasibility of continuing the protective electronic net from each end. It logically followed that from Pt. Barrow southward, and from Baffin Island eastward and southward, the DEW Line became first a joint responsibility of the Air Force and the Navy, with the Navy finally taking over to carry the unbroken radar skein both in the air and on the sea.

This called for highly specialized equipment. Fortunately the Navy had just what was needed. At the end of World War II great fleets of Destroyer Escorts, those highly effective antisubmarine ships, were carefully stored away just in case they might come in handy for future use. The Navy now found a use, and a thoroughly practical one, for these little ships which had first established an enviable reputation as doughty members of the Destroyer Force; and they are already carving a new niche of honor to occupy. A goodly supply of them was brought out of storage. First their superstructures were cleared off and they were newly topped with interesting housing to contain air-and-surface search and height-finding radars. With these changes the ships were given increased berth space and room for other needed electronic instruments. These efficient additions

to the radar line are known as the DER's.

The function of the DER's is an important one. Their stations lie off the coast lines, and as they cruise they are in constant contact with the nearest of the shore radar stations. When an unidentified plane is picked up by any one of the DER's sensitive radars, word is instantly flashed to the Aircraft Control and Warning Station ashore, with which the ship is in contact. This shore station may have information on this plane, in which case the necessity of further action is removed. All prearranged flight plans for all private, commercial, and military aircraft are scheduled and on hand or quickly available. However, if the flight in question cannot be identified, then the nearest interceptor base is notified, and in a matter of seconds jet fighters are in the air to identify, clear, or destroy the doubtful plane. No chances are ever taken. Definite identification must be finally made and the proper action taken. The DER commander remains in full contact throughout the period of interception, for the ship is so equipped as to be able to direct the interceptor squadron to the target by radar control. This, of course, is also a proper function of the shore station in case the DER cannot continue.

This was the first of the very practical sea methods the Navy employed in extending the protection of the DEW Line. Another, and more comprehensive, is the YAGR. In World War II the very serviceable but lumbering cargo carrier, the Liberty Ship, was designed and turned out in amazing quantities. They serviced

practically every military need all over the globe. At the end of the war when they were of no further use, the big question was what to do with them. They were big, bulky, slow, and cumbersome, but so wonderfully dependable it seemed a shame not to keep them. Now these almost cast-offs were preened for a prouder service. As an official part of the Navy they are now known as Picket Ships.

Still slow, about ten knots, very bulky, about 10,000-ton capacity, they are refurbished and refitted to carry almost every type of radar. The huge holds afford undoubtedly the most lush recreational and living quarters the Navy has at sea. There are basketball courts, movies, hobby shops and workrooms, and the best in food. There are excellent library and study facilities, and medical and hospital service and equipment. And most important to the men are the comfortable uncramped quarters with plenty of berth space and lockers. The ships carry a crew of 120 men and 15 officers and are almost the cruise ships of the service. Everything is done to remove the tedium of the three- to five-week tours of duty as these ships plot their courses to spread the web of radar.

All is well aboard them except—and there seems always to be an "except" in such ease and comfort in the service—that in the north seas in the winter a storm can roll 10,000 tons of ship nearly on her beam ends with no effort at all. This does make eating and sleeping a bit of a problem, but all in all, the YAGR's are a happy link in the extended service of the DEW Line.

The Navy has also turned over portions of her highly efficient air arm to the defense. The patrol aircraft have long served our shores as an integral part of the fleet. But now, as an actual participant in specialized DEW Line service, the Navy has converted the commercial version of the Lockheed Constellation to an airborne electronic laboratory. They are literally crammed with every possible type of radar equipment, and both the planes and the equipment are continually being improved in their effectiveness. The Navy calls them the WV2, the Air Force designates them as EC-121C, or the ED-121D.

These long-flying "Connies," with a normal capacity of about 3,500 miles, fly courses above the seaborne Picket Ships, thus more thoroughly making the skies impenetrable and augmenting and complementing the sea-level reconnaissance.

There may be a more lonesome place in the world than flying the Arctic leg of the DEW Line station, but the thirty-two-man crews of the Connies say they haven't found it.

The crews are made up of electronic technicians, radar and radio men, air controllers and flight crew, and one of their toughest jobs is fighting off the sheer tedium of the long uneventful hours as they fly over, under, through, and in spite of some of the dirtiest weather in the world. However, each man is fully aware of the importance of the task of more firmly binding together the security of the radar net.

Also augmenting the Picket Ships, the DER's, and

the Connies are the Navy blimps. These are the sturdy lighter-than-air ZPG-2W airships made by Goodyear, which are equipped to perform the same routine duty as the Connies, flying their service lanes connecting and interlocking the air radar and tying into the surface units below. Under the sea submarines, fitted with delicate sounding and electronic equipment, carry the net far into the depths. The Texas Towers, permanent radar-finding stations at sea, add their stability to this defensive mission.

With these co-operative naval activities, the DEW Line stretches past the continental limits from north to south as far as from three to five hundred miles at sea, and from the bottom of the sea it reaches toward the sky. The radar net is high, wide, deep, extremely effective, and very, very round. In effect, it is actually a 10,000-mile circle, manned and alert twenty-four hours a day.

The DEW Line has no end. And it's length across the Arctic is its most important link.

INSIDE THE CIRCLE

CHAPTER TEN

WITH THE DEW LINE, THE KEY LINK of our radar defense system, stretched and firmly anchored at each end, our radar "ring" is complete, all 10,000 miles of it. This constitutes the *earliest* warning line. Within this ring is a second one.

About a thousand miles south of the DEW Line is another radar screen, the Mid-Canada Line. This line is also called the McGill Line after the McGill University in Montreal whose scientists planned it. This is a chain of semiautomatic and fully automatic radar stations built along the 55th parallel that reaches from coast to coast. This line was built and fully financed by Canada, and is also manned and operated by the Dominion. However, it functions as a completely cooperative unit of the continental defense.

At either end of the Mid-Canada line the sea patrols once more extend the radar screen. This takes the form

of the inshore Picket Ships, the radar islands or Texas Towers, and the continental air reconnaissance. This constitutes the second circle of protective warning.

Within these lines there is still a third chain starting with the Pine Tree Line. This was the first of the radar "chains." It was built as a joint effort of the United States and Canada at a cost of some $250,000,000 and is jointly manned and maintained. It follows very closely the line of the United States-Canadian border. From each end of this line shore radar stations stud the coastline to complete the circuit.

The Ground Observer Corps, known as the GOC, is an extremely valuable adjunct to our defense warning system. It was organized in 1941 by the Office of Civil Defense. Although it would seem no longer necessary to maintain such an organization, it remains the only answer to the question: What if?

What if in some way DEW Line is knocked out? Or Mid-Canada Line sabotaged? Or Pine Tree Line put out of service? What if some way were devised of originating an enemy flight within our borders where there would be no peripheral radar to pass? These are possibilities, and even such apparently remote ideas cannot go unchallenged. The slogan might be: "If it's in the air and unidentified, find out before it's too late."

The Ground Observer Corps became a functional unit of the Continental Air Defense in 1954, and is active throughout Canada and the United States as a vital factor in our defense mechanism. Every member of the Corps is a volunteer, and an extremely

loyal one. It is now popularly known as "Operation Skywatch."

In its operation the United States and Canada have been charted into zones and graded into areas as to their critical importance. In each area a clearing post, or Filter Center, is maintained to which the "watchers" report any undue aerial activity or any flight that cannot be identified.

Throughout the United States there are approximately 15,000 observation posts, manned and operating. Of these, in what might be termed "critical" areas, more than 600 posts are serviced on a twenty-four-hour basis. There are an additional 12,000 posts partially manned. The national total of volunteers in the Ground Observer Corps is more than 400,000 men and women, boys and girls, working in the observation posts in the zoned areas and reporting their findings through the 67 Main Filter Centers.

For an operation as essential as this, the mechanics are relatively simple. Scattered throughout the land on farms, in towns, at crossroads, or on the roofs of city buildings, anywhere and everywhere that offers a clear view of the sky, the watchers are at work. They are trained to recognize types of aircraft by sight, and are acquainted with the more common flight patterns along commercial air lanes. Their posts may be a simple shack with observation porches, or a chair on a rooftop. Other than eyes and ears their only need is for a telephone. The government pays for the installation of the telephone, and for such calls as are made to the clearing

point at the area's Filter Center. All else—the expense of building, equipping, and servicing the local observation posts—is paid for by the members of each post.

The Filter Centers are government-maintained and are the official liaison units between the individual watching-post and the Defense Command in Colorado. These Centers are manned by the Air Force, are on full-time duty, and receive the advices from the local posts by telephone. The data are charted on a large plexiglass map of the zone area. If the pattern shows information that requires further attention, this news is at once transmitted to CONAD where it appears on the big map for official notice, and, if necessary, checked by a jet interceptor from the base nearest the alarm. Here again, no chances are taken by the top command, the Filter Center, or the GOC watcher. One mistake or a careless error might be serious.

Besides reporting on planes, the sky watchers also report weather conditions, tornadoes, accidents, and any untoward local condition that might be of interest elsewhere. The call into the phone, "Aircraft Flash!" gives the post quick contact with their Filter Center. If the report from the observer is of weather, that too is passed along generously to whomsoever it might be of interest. Many emergencies are quickly and ably handled by the centers.

Local groups of watchers are formed, and they take active part in the organization, wearing their GOC "wings" with justifiable pride. Most areas publish a monthly bulletin of the doings of their groups, with in-

teresting stories of who is doing what, and with hints to watchers and data on new designs of enemy aircraft to memorize. These community groups are thus knit into the firm pattern of our national defense.

The identification-watching-job is not easy. It takes time, it cuts into personal, more pleasurable activities, but it is an unselfish act of patriotism. There is a daily average of more than 30,000 scheduled flights over the American continent. There is, however, a tight system of control over aircraft. Planes which plan to fly within probable target areas must file flight plans for clearance. "Air corridors" are established for the use of airlines. Any deviation from a security pattern, or any questionable plane calls forth the jet interceptors who either clear it, or force it down for inspection. And now the apparently infallible "brains" of electronic robots are figuring new ways to get the answers as to the types of plane in the air.

Most of the planes become like old friends to the watchers, who are familiar with scheduled flights, and are kept advised about any unusual air activity that might concern them. Members of the GOC are almost like bank tellers behind wickets who know the sight and feel of good money so thoroughly that the counterfeit bill is easily and quickly detected. This training of the watchers is an important activity of the Corps. For in order to avoid confusion only those planes are reported to the Filter Centers whose identities are seriously questioned; but here, as in other branches of defense, no chances are taken.

This patriotic service may at times seem to be a monotonous chore, watching, nothing but watching. But it is a necessary job, for in no better way can the air within our borders be so satisfactorily and successfully scanned.

The entire Operation Skywatch, with its detail of civilian instruction is under the able command of Colonel Broun Mayall, USAF, Director of Civil Defense at CONAD.

Three years after Operation Skywatch had become an official member of CONAD, Charles E. Wilson, Secretary of Defense, wrote the following message to the Secretary of the Air Force:

MEMORANDUM FOR:
The Secretary of the Air Force
Department of the Air Force
SUBJECT:
Third Anniversary of Operation Skywatch

I have received the attached letter from the President in which he asks that his respect and admiration for and appreciation of the work being done by the Ground Observers be conveyed to the past and present members of the Corps, on the third anniversary of Operation Skywatch. Every American owes a debt of gratitude to those volunteers of the Ground Observer Corps for their tedious work scanning the skies for an aircraft they hope is never seen. These volunteers have effectively contributed to the

continental defense system by their individual and cooperative effort. In transmitting the President's letter on the observance of this anniversary, I wish to extend to each member of the Ground Observer Corps my personal congratulations and gratitude.

CHARLES E. WILSON

The highly congratulatory letter, to which the Secretary of Defense referred, follows:

THE WHITE HOUSE, WASHINGTON

Dear Mr. Secretary:

The third anniversary of Operation Skywatch on July 14th affords me an opportunity to express once again my respect and admiration for those citizens who continue to give unselfishly of their time and effort in the Ground Observer Corps.

Through their steadfastness they help to do, in the only way it can be done, a job of vital importance to all Americans. To all the Ground Observer Corps I should like to say again that I cannot overemphasize the importance of the role they, volunteers, play in national defense. As you have pointed out, they have undoubtedly strengthened the capabilities of our continental defense system, and in so doing they have helped to deter aggression.

As you mark the third anniversary of Skywatch, please convey to all Ground Observers past and

present, my personal word of appreciation and congratulations. I hope the effort to seek additional volunteers for the expanded program will meet with the greatest success.

Sincerely,
DWIGHT D. EISENHOWER

The Honorable Charles E. Wilson
Secretary of Defense,
Washington, D.C.

The GOC is a proud organization of loyal Americans. It is an unselfish hard-working organization, and as other loyal Americans learn how they may take an active interest in this essential part of our national defense, the GOC will continue to grow. For the GOC needs every pair of eyes it can get for the fullest success of Operation Skywatch.

The focal point of all three radar lines is the command headquarters of CONAD at Colorado Springs. The United States and Canada are within its safekeeping. How well we are protected depends not so much upon the lines as upon what we are doing inside them. For the circles, as tightly woven a radar web as was ever formed, have one purpose only. They could not possibly stop a single plane of an enemy air attack from reaching a target, for they have no weapons of any sort. Their sole function is to warn.

It has cost many hundreds of millions of dollars to build the circles. The DEW Line alone across the Arctic

cost a minimum of $500,000,000 to erect, to say nothing of the Texas Towers, the converted ships for the naval patrols, and the extended air reconnaissance. Beyond this the maintenance, improvement, and supply of the system runs into fabulous figures annually. Canada has invested more than $200,000,000 in her Mid-Canada Line, and more millions were jointly spent for the Pine Tree Line. In the minds of many the question arises, since this entire system is nothing but a connected string of outlying listening posts, is it worth it?

Paul Revere had a horse, a couple of lanterns, and a friend. Between them they succeeded in warning a countryside one night in 1775, with the result that the Massachusetts farmers successfully stopped and turned back the invading British troops. There's no record that Mr. Revere ever fired a shot, but his feat is a classic example of the importance of a warning of impending attack. The New England farmers were armed, expectant, and needed only this warning to form their thin but effective line to repel the invaders.

There are other types of awakenings. Even the cheapest alarm clock can put forth such a racket as could raise a neighborhood, but if the sleepers either take the noise for granted and ignore it, or cover their ears to shut it out and turn over for a few extra winks, the alert has been a useless effort. All the screaming sirens in the state sounding off at once would have no effect at all on the populace if all the people only complained about the noise they made. The chilling siren of a fire engine would never alarm anyone if they were

not convinced that there was a fire, nor would the arrival of police cars cause the least disturbance if people were not convinced that the officers were performing a duty for the good and safety of their neighborhood by searching out and capturing a lawbreaker.

Our very wonderful DEW Line, the miracle link of our radar loops, by the same token, would be as useless as a broken penny whistle if we, the people within its protective limits, shrugged off the potential warnings as so much electronic theatrics for dramatizing the need of increased spending for defense purposes.

Recently, in a release dated February 20, 1957, Charles E. Wilson, Secretary of Defense, on the subject of our defensive weapons and their deployment, said, "Deployment of these weapons does not mean that the government has any specific expectation of air attacks. Pending international agreement on safeguarded disarmament, the United States, like other responsible governments, must take prudent steps to guard against possible attack in the future."

It was upon this same sound premise of our being a potential target that our present form of Continental Air Defense Command was formed in 1954. This unit form of unified active control of our defense mechanisms was established by the Joint Chiefs of Staff to accomplish the one thing that might keep Canada and ourselves free from destructive attack.

An over-all picture of our continental defense system is comfortably reassuring. However, as highly as our defense is developed and as much as is constantly being

done to improve its efficiency, we dare never become lethargic or complacent. We must continue every effort to keep our defense system at its protective powerful best. Every part is designed and integrated to save time in order that we may gain every possible advantage in launching our counterattack. The component parts of the Air Force, Navy, Army, and the Ground Observer Corps become a most practical smoothly-operating unit as CONAD. But however efficient each arm of the service may be, its effectiveness as a protective force depends upon the time, its warning time.

Bearing in mind that a primary factor in our system of defense is time, follow the actions of how these warning systems will operate in case of attack.

For the first example, let's see how the DEW Line works. Assume that a force of unidentified planes approaching from the north is caught by one of the screens of DEW Line radar. This news is at once radioed by high-wave scatter broadcast to be picked up by the receivers at Colorado Springs, and the information charted on the big map at Combat Operations Center. With this, the DEW Line has served its purpose.

With the information that a large number of unidentified aircraft is headed south, the first action is to find out who and what they are, so interceptors, either U. S. or Canadian, are sent aloft to learn the answer. At the first news of such a mass flight, the invaders and interceptors may be considerable distance and time apart, but at supersonic speed it would not take long to close the gap.

The invaders, once they have passed through the radar shield of the DEW Line, may well change their course and head for their ultimate target. But the radar "fix" from the DEW Line has fastened the electronic brains of the interceptors on the trail and the meeting is inevitable.

The Mid-Canada Line would next pick up the invaders' flight, and in turn flash this news to the command in Colorado and to its own RCAF interceptor bases. The jets already in the air would continue, changing course as required, and thus would always be "on the target." Each added bit of information would be essential to the officers at the Combat Center for their proper direction of the impending fight.

Interception might come at any moment, and when it does, the result will be terrifying. Imagine a bombing force of any imaginable number, loaded with every type of destructive nuclear weapon, trying to get by hundreds of jet fighters with equally destructive rocket weapons. The clash would be unbelievable in its fury. Perhaps the invaders would be willing to sacrifice their major effort in the hope that just a few or even one of their bombers could get through. If so, a third warning would come from the Pine Tree Line, and thus pinpoint the target area of such plane or planes as had been successful in penetrating the interception. This final warning would give no more than a very few minutes before the bombers would be over the key objective of their invasion, and in these final moments, the safety of the target area would depend upon the Army installa-

tions of ground-to-air guided missiles, and antiaircraft artillery.

Such an attack directed across the Arctic might conceivably be directed toward our Middle West, at some of our major manufacturing centers such as Cleveland, Detroit, Gary or Chicago. It is also possible that an attack might be directed over our coast line to reach the seat of government in Washington, or to bomb New York or Philadelphia.

If an attack should come by sea, the format would follow much the same pattern but with a few important additions. The outer radar ring would first identify the intruders and radio the nearest shore patrol station. Progressively the course of an enemy flight would be followed in the same manner as by the three chains in Canada, but instead of Air Force interceptors alone, Navy air fighters, carrier planes, and Navy shore emplacements would take part in the action. Therefore, besides the command in Colorado, subcommand at shore sites would co-direct these interceptions with every plane radar-guided to its target.

The object of all interception flights is to one, intercept; two, identify; three, destroy . . . destroy *every* attacking bomber before a single bomb can be dropped. If one, only *one,* plane should succeed in reaching its target, and one, just *one,* bomb should be dropped, the result would be the greatest horror the world has ever known.

As the pattern of an invasion flight is made apparent on the big control maps, with from four to six hours in

which to prepare, quick crisp orders are issued by the CONAD Commander-in-Chief, first for the protection of the people living within the possibly doomed area, to evacuate cities and to take every possible protective measure for personal safety. Every arm of our military services would be alerted for all-out combat duty, for unavoidably, we would be at war.

We have our warning system, and its effectiveness is constantly improving as new details are added. But our actual defense lies in the power of our Air Force, Navy, and Army. And this power too is increasing day by day.

There are items of a new interceptor jet capable of 1,500 miles an hour; new guided missiles with probable speeds up to 15,000 miles an hour; single explosive charges capable of annihilating a whole city and contaminating thousands of square miles of land; millions and billions of dollars spent for planes, defense systems, electronic machines, and missiles.

There are machines which can gauge the speed of a supersonic plane, establish a point of interception, chart the trajectory of a missile from its ground launching spot, then fire the missile and continue the computations to accord with changes of speed or course of the plane, and so change the radar-guided missile's course to an infallible destructive contact. Such machines exist, are in operation, and can perform these almost impossible calculations and actions without the help of a human being. It would be an impossible feat for all the master mathematicians in the world to solve such a

problem before the plane would achieve its mission. The machine does it in a matter of seconds.

Such things as this, and they are electronically common, are beyond the understanding of most of us.

In our system of national defense we also have a thing called SAGE, the "semi-automatic-ground-environment," which was developed in the Lincoln Laboratories of the Massachusetts Institute of Technology, the same place that gave birth to the idea of the DEW Line. SAGE is a super-electronic device with a memory and has been installed under Air Force contract by Western Electric. It automatically calculates the most effective uses of weapons, missiles, antiaircraft guns, commits these data to "memory," gives answers to the varying uses of ground or air equipment, and can change the structure of battle during its progress; it can also transfer pertinent information to adjacent computers. It selects targets, guides missiles, changes courses, and literally performs what would be impossible for man to do. Such a machine cannot easily be comprehended by most of us.

There are missiles with strange and interesting names, such as the Nike, named after the Greek goddess of Victory. This is a twenty-foot ground-to-air rocket. Many cities throughout the country already have Nike antiaircraft emplacements. Thousands of people have seen them, but would the average sightseer understand that each rocket with its fabulously complex mechanism composed of 1,500,000 parts, is capable of being launched electronically and radar-

guided to destroy an attack plane at least thirty miles away? Or that these emplacements are activated, on twenty-four-hour alert, and ready for instant use?

However, even as these Nikes are being installed, they are obsolete. The "new" Nike, called the Nike-Hercules, is being built to replace them. The first Nike, Nike-Ajax, has a thirty-mile range; the new Hercules will carry about ninety miles. The Ajax has a TNT warhead; the Hercules' is nuclear. The Hercules is ten feet longer and five times heavier. The Hercules, therefore, is an advanced step in nuclear antiaircraft defense.

Wherever the Nike emplacements have been established in our cities, 50mm antiaircraft guns are also installed.

There are many other types of missiles developed by the Air Force, Army, and Navy, each with a different function and of assorted accomplishments and with equally interesting code names. There is the Corporal, Honest John, Redstone, Regulus, Terrier, Sparrow, Sidewinder, Matador, Snark, Falcon, to name a few, and the bombs, the terrifying nuclear and hydrogen bombs.

We are told that the IRBM, the intermediate-range ballistic missile, is not too far away, that perhaps at almost any time we will be able to launch a nuclear missile capable of 1,500 miles of guided destruction, traveling at about 15,000 miles per hour. Then, following this, is the ICBM, the intercontinental ballistic missile, which is already far into the planning stages.

Hundreds of missile tests are fired every month

with no eyes needed to sight or finger to pull a trigger. Machines do the range-calculations, the target-sighting, the missile-guiding, even in some instances the ultimate firing of the missile's destructive charge.

These are representative of the varied striking force available, in addition to the planes themselves. It is a complex and powerful force equal to the job, but created at immense expense. However, as long as the arms race continues, we must meet the challenge. We may achieve the strongest arms the world has ever known in air, on the seas, or ground, and yet be subjected to annihilating defeat unless we have a warning. Thanks to DEW Line, our magnificent warning line in the North, we now have four to six hours of warning in case of attack.

Such attacks are neither impossible nor improbable. And there appears to be no way to prevent such attacks except to be so fully ready to defend ourselves and to take such overwhelmingly powerful retaliatory action that it would be suicide for any enemy to attack us.

There never yet has been a formula for outguessing the unpredictable. Therefore, the only logical way to checkmate is to be prepared to win no matter which way the other jumps. This sometimes is a most expensive project, but it's worth it whatever the cost when our lives and the very existence of our nation depend upon it.

The DEW Line may well be our lifeline!

Credits for Photographs

The following list acknowledges the source of the photographs on the illustration pages 49 to 64. The credits are given in the order of the pictures' appearance on the pages, top to bottom.

Page 49: Western Electric Co., U. S. Air Force; page 50: Western Electric Co., Western Electric Co.; page 51: Dept. of National Defense (Canada), Western Electric Co., Western Electric Co.; page 52: Western Electric Co., Dept. of National Defense (Canada); page 53: Western Electric Co., U.S. Air Force, Western Electric Co.; page 54: Western Electric Co., U.S. Air Force; page 55: Dept. of National Defense (Canada), Western Electric Co., Western Electric Co.; page 56: Dept. of National Defense (Canada), Western Electric Co., Dept. of National Defense (Canada); page 57: Western Electric Co.; page 58: Western Electric Co., U.S. Air Force; page 59: Western Electric Co., Western Electric Co.; page 60: U.S. Air Force, U.S. Air Force; page 61: U.S. Air Force, U.S. Air Force; page 62: CONAD, U.S. Navy; page 63: U.S. Navy, U.S. Navy, U.S. Navy; page 64: CONAD, U.S. Air Force, U.S. Army.

Printed in U.S.A.